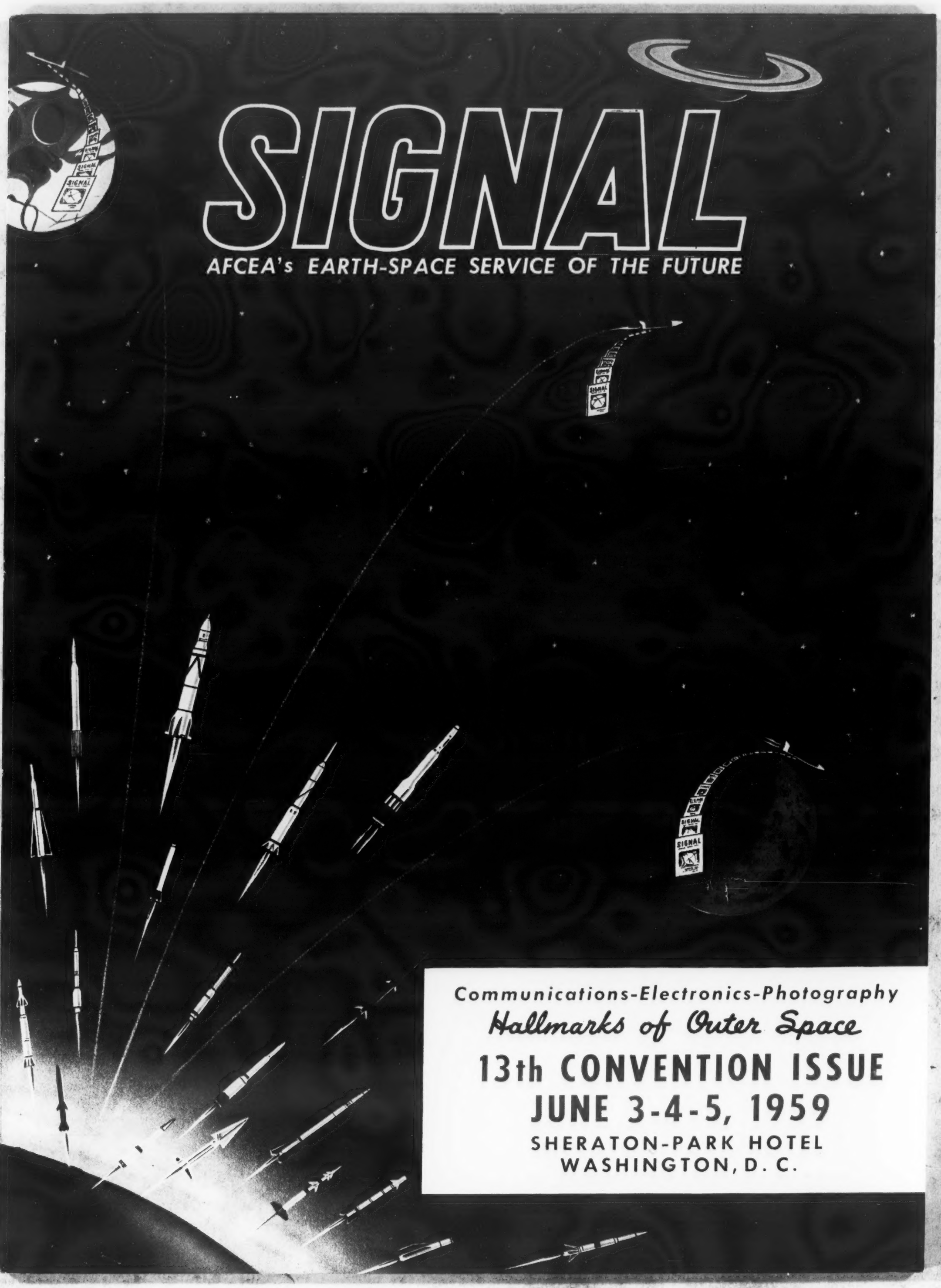
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Hallmarks of Outer Space
13th CONVENTION ISSUE
JUNE 3-4-5, 1959
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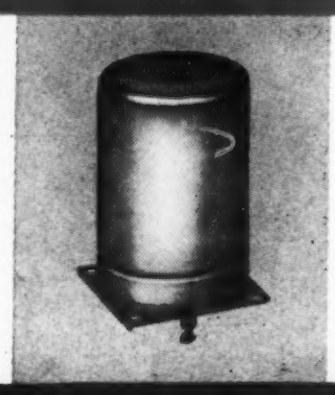
Type No	Application	MIL Type	Pri. Imp. Ohms	Sec. Imp. Ohms	Unbal. DC in Pri. MA	Response 2 db (Cyc.)	Max. level dbm
H-1	Mike, pickup. line to grid	TF4RX10YY	50, 200CT, 500CT	50,000	0	50-10,000	+ 5
H-2	Mike to grid	TF4RX11YY	82	135,000	50	250-8,000	+18
H-5	Single plate to P.P. grids	TF4RX15YY	15,000	95,000 CT	0	50-10,000	+ 5
H-6	Single plate to P.P. grids, DC in Pri.	TF4RX15YY	15,000	95,000 split	4	200-10,000	+11
H-7	Single or P.P. plates to line	TF4RX13YY	20,000 CT	150/600	4	200-10,000	+21
H-8	Mixing and matching	TF4RX16YY	150/600	600 CT	0	50-10,000	+ 8
H-14	Transistor Interstage	TF4RX13YY	10K/2.5K, Split	4K/1K split	4	100-10,000	+20
H-15	Transistor to line	TF4RX13YY	1,500 CT	500/125 split	8	100-10,000	+20

Type No.	Application	MIL Type	Pri. Imp. Ohms	Sec. Imp. Ohms	Unbal. DC in Pri. MA	Response + 2 db (Cvc.)	Max. level dbm
H-20	Single plate to 2 grids, can also be used for P.P. plates	TF4RX15YY	15,000 split	80,000 split	0	30-20,000	+12
H-21	Single plate to P.P. grids, DC in Pri.	TF4RX15YY	15,000	80,000 split	8	100-20,000	+23
H-22	Single plate to multiple line	TF4RX13YY	15,000	50/200, 125/500	8	50-20,000	+23
H-23	P.P. plates to multiple line	TF4RX13YY	30,000 split	50/200, 125/500	8 BAL.	30-20,000	+19
H-24	Reactor	TF4RX20YY	450 Hys.-0 DC, 250 Hys.-5 Ma. DC, 6000 ohms 65 Hys.-10 Ma. DC, 1500 ohms				
H-25	Mixing or transistors to line	TF4RX17YY	500 CT	500/125 split	20	40-10,000	+30

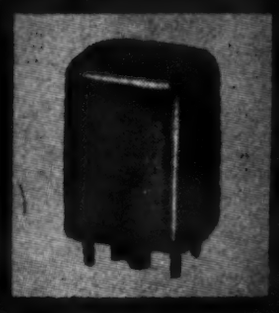


Typical Compact Audios

RC-50 Case
1-5/8 x 1-5/8 x 2-5/16
8 oz.

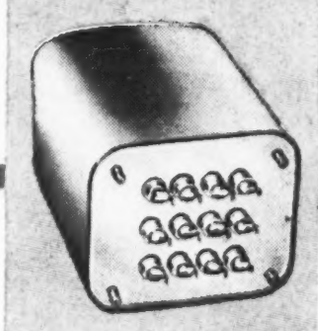
Typical Subminiature Audios

SM Case
1/2 x 11/16 x 29/32
.8 oz.



Type No	Application	MIL Type	Pri. Imp. Ohms	Sec. Imp. Ohms	Unbal. DC in Pri. MA	Response + 2 db (Cyc.)	Max. level dbm
H-31	Single plate to 1 grid, 3:1	TF4RX15YY	10,000	90,000	0	300-10,000	+13
H-32	Single plate to line	TF4RX13YY	10,000	200	3	300-10,000	+13
H-33	Single plate to low imp.	TF4RX13YY	30,000	50	1	300-10,000	+15
H-35	Reactor	TF4RX20YY	100 Henries-0 DC, 50 Henries-1 Ma. DC, 4,400 ohms.				
H-36	Transistor Interstage	TF4RX15YY	25,000 (DCR800)	1,000 (DCR110)	.5	300-10,000	+10
H-39	Transistor Interstage	TF4RX13YY	10,000 CT (DCR600)	2,000 CT	2	300-10,000	+15
H-40A	Transistor output	TF4RX17YY	500 CT (DCR26)	600 CT	10	300-10,000	+15

Type No.	HV Sec. CT	DC MA*	Military Rating Fil. Secs.	DC MA*	Industrial Rating Fil. Secs.	Case
H-80	450	120	6.3V,2A	130	6.3V,2.5A.	FA
H-81	500/550	65/55	6.3V,3A-5V,2A	75/65	6.3V,3A.-5V,2A.	HA
H-82	540/600	110/65	6.3V,4A.-5V,2A.	180/100	6.3V,4A.-5V,2A.	JB
H-84	700/750	170/110	6.3V,5A.-6.3V,1A.,5V-3A.	210/150	6.3V,6A.-6.3V,1.5A.-5V,4A.	KA
H-89	850/1050	320/280	6.3V,8A.-6.3V,4A.,5V-6A.	400/320	6.3V,8A.-6.3V,4A.-3V,6A.	OA



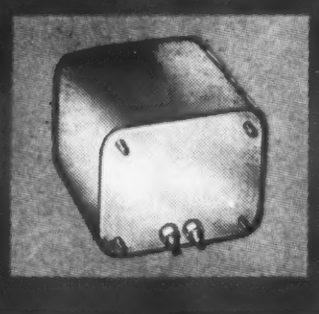
Typical Power Transformers

Pri: 115V 50/60 Cyc.
***Choke/Cond. inp.**

Type No.	Sec. Volts	Amps.	Test Volts	Case	Type No.	Sec. Volts	Amps.	Test Volts	Case
H-121	2.5	10(12)	10 KV	JB	H-131	6.3 CT	2(2.5)	2500	FB
H-122	2.5	20(26)	10 KV	KB	H-132	6.3 CT 6.3 CT	6(7) 6(7)	2500	JA
H-125	5	10(12)	10 KV	KB	H-133	6.3 CT	7(8)	2500	HB
H-130	6.3 CT	.6(.75)	1500	AJ	H-134	6.3 CT	10(12)	2500	HA

Typical Filament Transformers

Pri: 105/115/210/220V except H-130 (115) and H-131 (115/220) 50/60 Cyc.



Type No.	MIL Type	Ind. Hys.	@ MA DC	Ind. Hys.	@ MA DC	Ind. Hys.	@ MA DC	Ind. Hys.	@ MA DC	Res. Ohms	Max. DCV Ch. Input	Test V. RMS	Case
H-71	TF1RX04FB	20	40	18.5	50	15.5	60	10	70	350	500	2500	FB
H-73	TF1RX04HB	11	100	9.5	125	7.5	150	5.5	175	150	700	2500	HB
H-75	TF1RX04KB	11	200	10	230	8.5	250	6.5	300	90	700	2500	KB
H-77	TF1RX04MB	10	300	9	350	8	390	6.5	435	60	2000	5500	MB
H-79	TF1RX04YY	7	800	6.5	900	6	1000	5.5	1250	20	3000	9000	7x7x8

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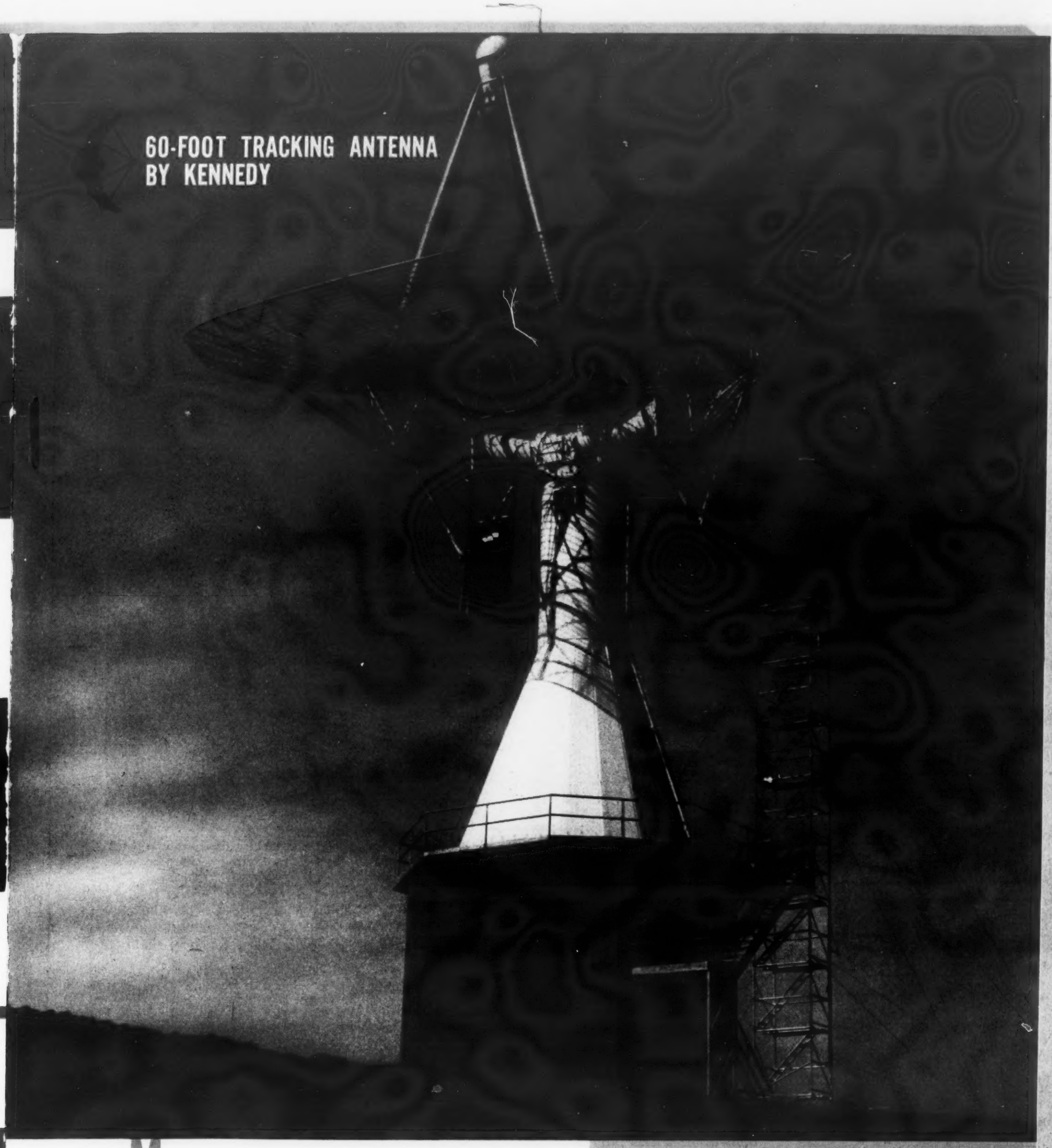

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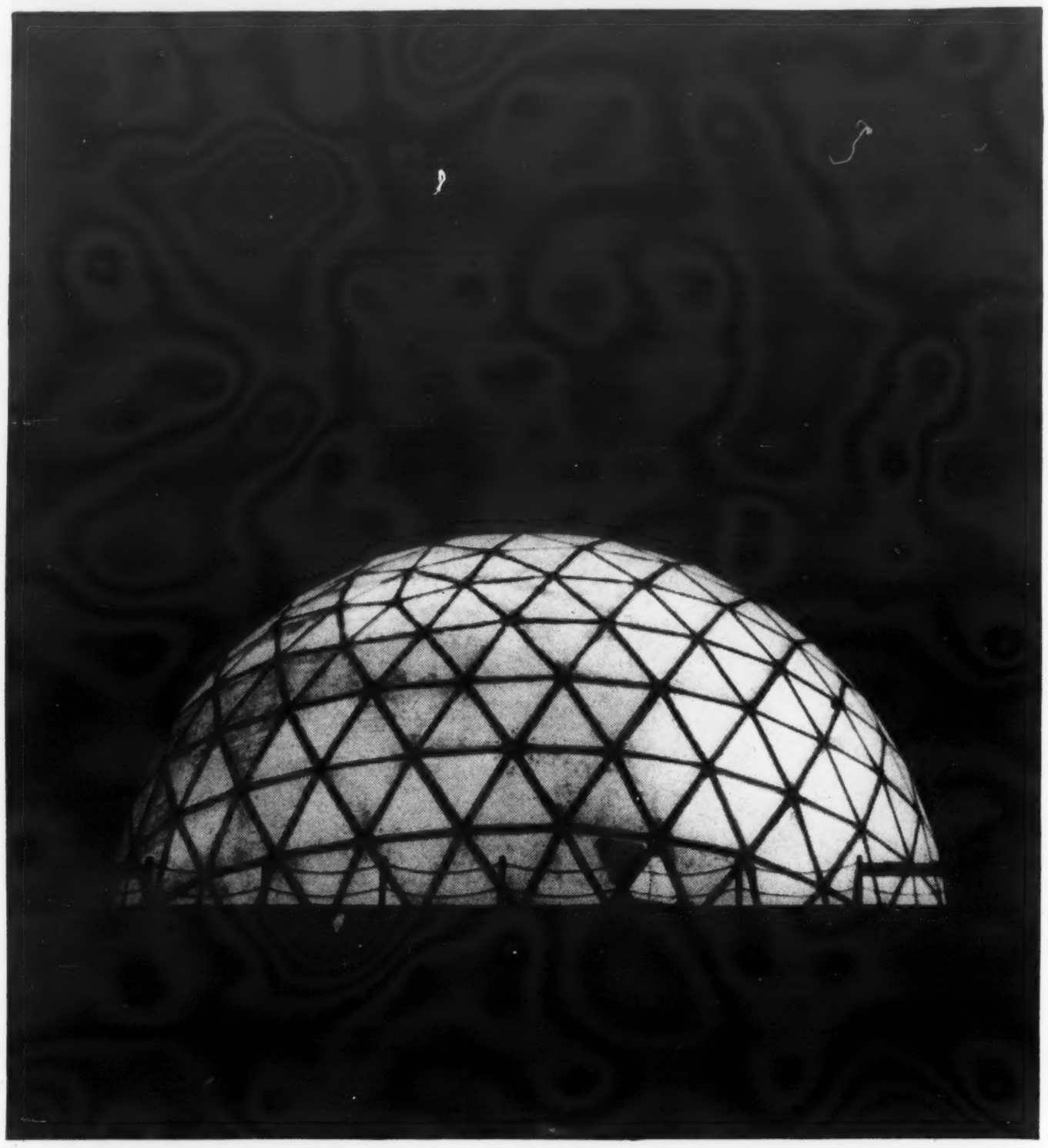
THE ARCTIC EYE THAT NEVER SLEEPS



This plastic radome houses a radar antenna constantly scanning the skies to detect the presence of aircraft. A line of these radars provides early warning of any threatening approach to the North American continent.

The Distant Early Warning Line is now on perpetual guard duty. Spanning the Arctic from Baffin Island to Alaska, this great system was conceived at the Lincoln Laboratory of M.I.T. and produced under the leadership of Western Electric, the Bell System's manufacturing and supply unit.

But first the DEW Line had to be engineered into a workable system. This was done at Bell Telephone Laboratories.

The obstacles were formidable. Conventional means of communication—telephone poles, cables and even line-of-sight microwave radio—weren't feasible. A complicated system had to be made to operate reliably in a climate so cold that outdoor maintenance is impracticable farther than a few hundred feet from heated habitation.

Whenever possible, Bell Laboratories engineers utilized well-proven art. But as it became necessary, they innovated. For example, they designed and directed the development of a new and superior radar which automatically scans the skies, pinpoints a plane and alerts the operator.

To reach around the horizon from one radar station to another, they applied on a massive scale a development which they pioneered—transmission by tropospheric scatter. Result: at a DEW Line Station you can dial directly a station more than a thousand miles away and converse as clearly as with your home telephone.

The Bell System's contribution to the DEW Line demonstrates again how telephone science works for the defense of America.

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Cover: Conceived in AFCEA Signal Dept., the concept of missiles departing from earth (lower left) is by courtesy of Eastern Industries.

BPA

SIGNAL

Communications-Electronics-Photography

Journal of the Armed Forces Communications and Electronics Association

VOLUME XIII MAY 1959 NUMBER 9

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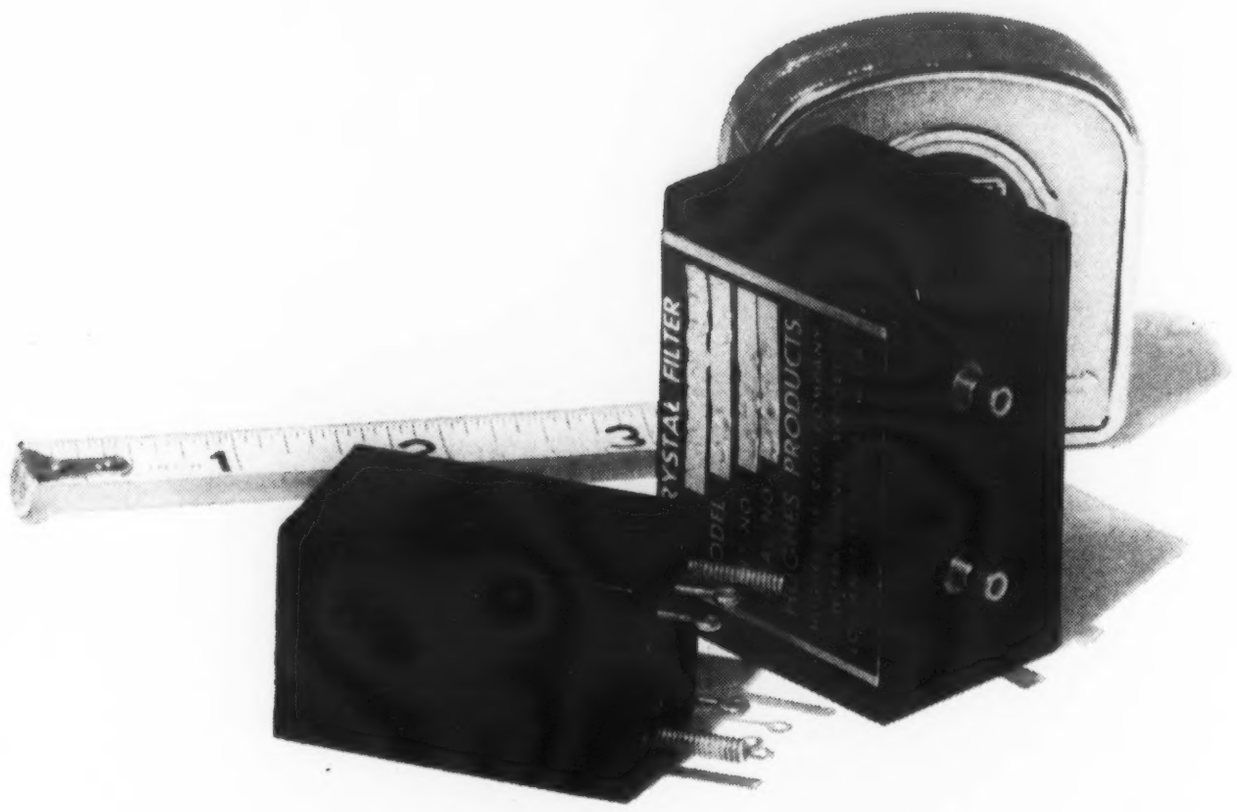

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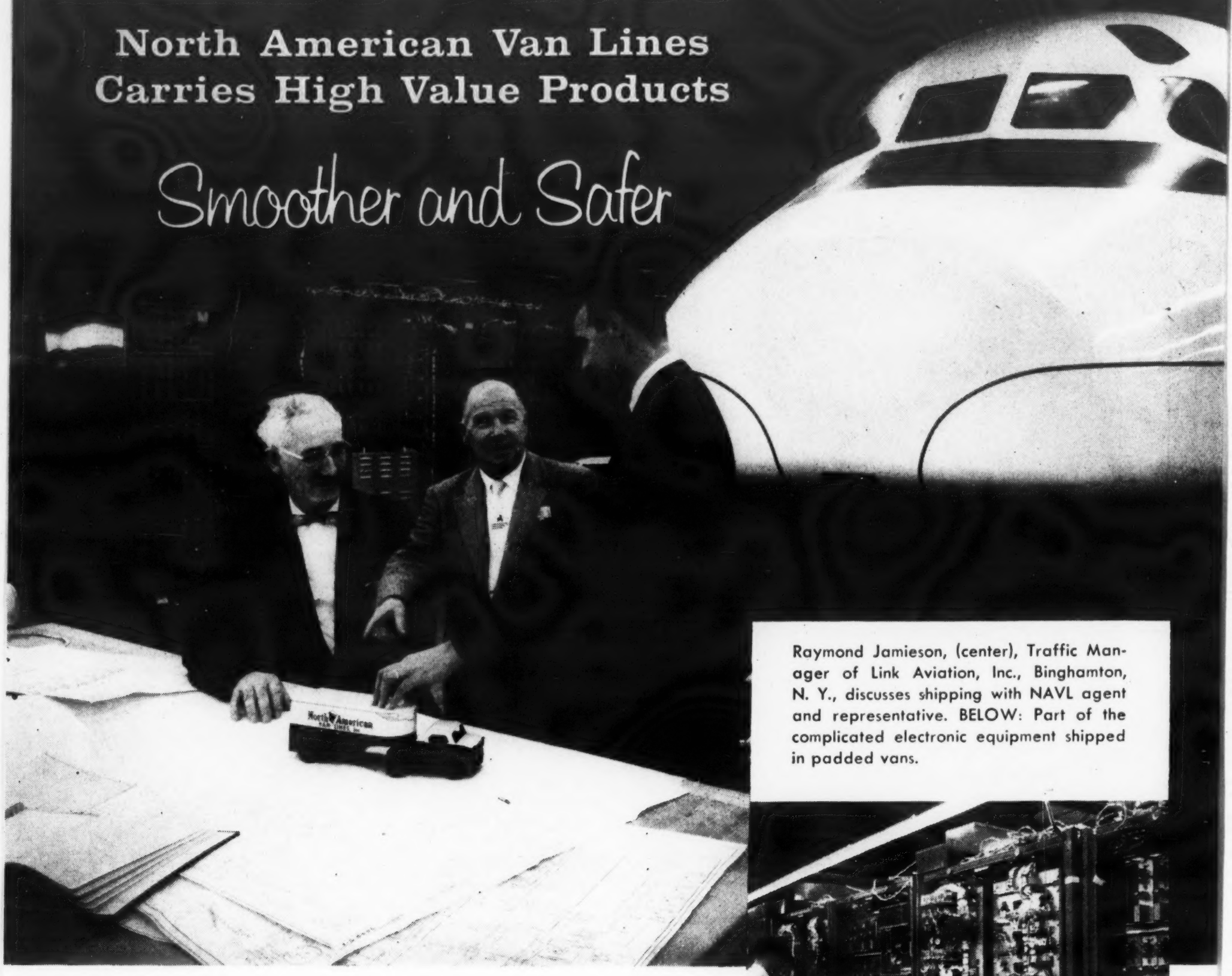
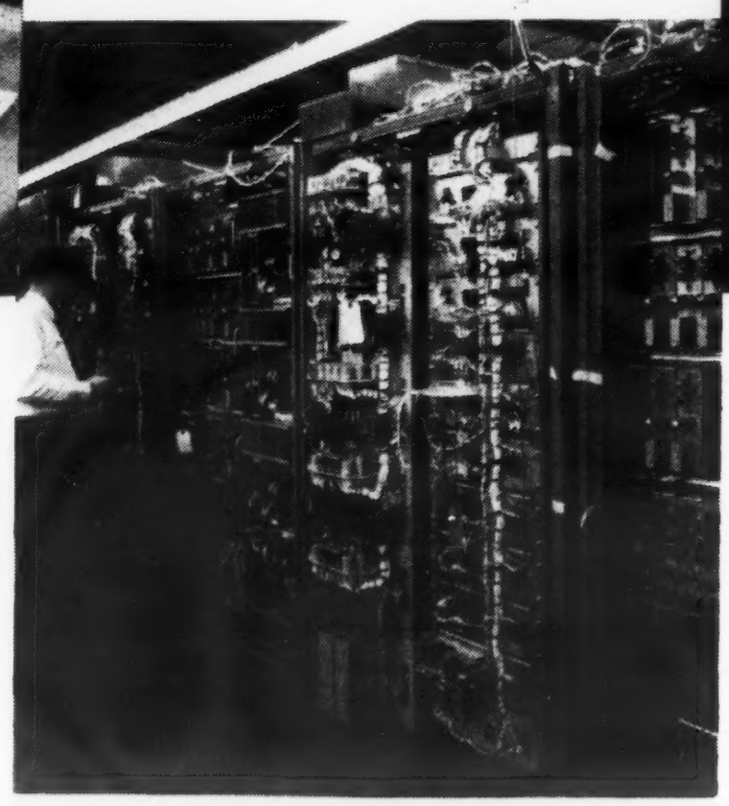


Raymond Jamieson, (center), Traffic Manager of Link Aviation, Inc., Binghamton, N. Y., discusses shipping with NAVL agent and representative. BELOW: Part of the complicated electronic equipment shipped in padded vans.



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give my regards to Venus. Messages like that may become matter-of-fact sooner than we think. The field of space communications is one in which we at Bendix Radio are making exciting progress. Our engineers are developing systems to provide communication links with the first manned space vehicles, and we are already playing a major part in communications and tracking in connection with the earth satellite program. Also under study at Bendix Radio are improved systems for more conventional applications—such as speech security and forward scatter. *Your* problems in communications could well find their answer with us.

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THE WHITE HOUSE

WASHINGTON

April 30, 1959

Dear Admiral Furth:

Please give my greetings to those attending the Thirteenth Annual Convention of the Armed Forces Communications and Electronics Association.

Your theme, "Communications, Electronics and Photography -- Hallmarks of Outer Space," illustrates the modern mind of your Association. As your members help to marshal American resources of skill and knowledge, they strengthen us all in our ability to meet the challenge of this era.

I am delighted to add best wishes for a fine convention.

Sincerely,

Dwight D. Eisenhower

Rear Admiral Frederick R. Furth, USN, (Ret.)
President
Armed Forces Communications
and Electronics Association
1624 Eye Street, N. W.
Washington 6, D. C.

PRESIDENT FREDERICK R. FURTH

Rear Admiral, USN (Ret.)
Vice President, ITT Corp.
NATIONAL PRESIDENT, AFCEA

Welcome

As President of the Armed Forces Communications and Electronics Association, it is a privilege to extend a most cordial welcome to all who are attending the 13th AFCEA Annual Convention and a personal greeting to those who, because of previous commitments, cannot be with us.

As we move progressively forward in this electronics, communications and photographic age of miracles, there is little wonder why we find it increasingly more difficult to keep abreast with the happenings and prodigious strides of accomplishments which occur almost daily. I am sure that the programs and exhibits planned for this largest of electronics shows in the Nation's Capital as well as the opportunity to discuss important events on an informal level, will go a long way in bringing all of us in balance with present activities in these significant fields.

The growing power of the Soviet economy poses an ever increasing challenge to our American way of life. The nature and character of this challenge calls for a profound understanding of our economic objectives as they relate to our scientific and technological advancements. This is why we have chosen as our convention theme — "Communications, Electronics, Photography — Hallmarks of Outer Space." For it carries the connotation that by keeping pace scientifically, militarily and economically, we can parallel the strides of any nation whose aims are more aggressive than peaceful.

It is my personal conviction that the members of our Association and friends participating in the Convention will make a major contribution which will strengthen our national security.

Convention Speakers

General Curtis E. LeMay
Vice Chief of Staff, USAF

KEYNOTE LUNCHEON SPEAKER

To be introduced by Maj. Gen. Francis L. Ankenbrandt, RCA

General Curtis E. LeMay, affectionately known as Curt, holds the admiration and respect of all Americans for his adventurous spirit and pioneering in aviation during the past thirty years. Never idle and always working with prodigious effort to increase the power and reliability of our nation's Air Force, he has given unselfishly of his time, talent and imaginative thinking to the development of one of the greatest military deterrents to world conflict.

Serving with distinction in World War II, he introduced formation pattern bombing; put into tactical use the combat formation utilizing 18 aircraft in each group, and in 1943 led the famous shuttle mission of Flying Fortresses from England to Africa (Target: Regensburg, Germany).

His good-will flights in 1937 and 1938 to South America of B-17 Flying Fortresses as well as his pioneering of ferry routes to Africa via South America and the South Atlantic and to England via the North Atlantic are a matter of recorded history. More recently, he is known as the man who really made "SAC" and for his recent record-breaking flights to South America.

★ ★ ★ ★

BANQUET SPEAKER

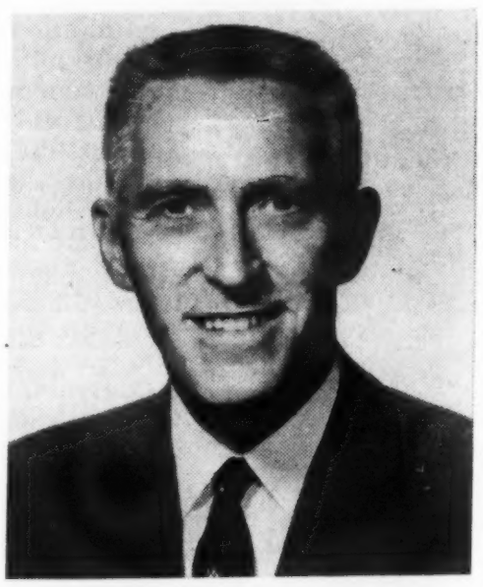
To be introduced by Maj. Gen. W. Preston Corderman, Times Facsimile Corp.

Our banquet speaker, the former Governor of Iowa and the present and first Presidential appointee as Director of the Office of Civil and Defense Mobilization, was born in Audubon County, Iowa, March 30, 1908.

Governor Hoegh began his public service career by serving for three successive terms (1937, 1939, 1941) in the Iowa House of Representatives; as Attorney General of Iowa in 1953 and 1954; as Governor from 1955 to 1957; and as Director of the Federal Civil Defense Administration to July 1, 1958.

Governor Hoegh graduated from the University of Iowa in 1929 with a B.A. degree, and in 1932 he received his L.L.B. and was admitted to the Iowa Bar.

For his outstanding service in World War II, he rose from platoon leader to a battlefield promotion of Lieutenant Colonel and earned the Bronze Star, the French Legion of Honor and the Croix de Guerre. Governor Hoegh is the author of *Timberwolf Tracks*, and is a member of several collegiate and fraternal organizations and the American Legion. In his present position of great responsibility, he holds the respect of members of Congress and his associates for his leadership and executive ability.



Governor Leo A. Hoegh, Director of Civil and Defense Mobilization

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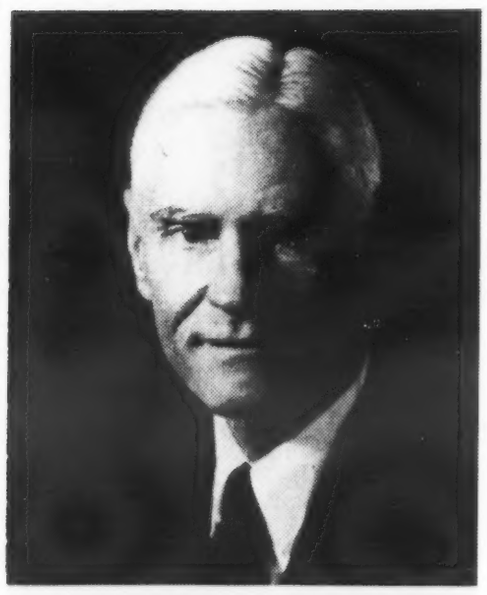


J. Carlton Ward, Jr., President, Vitro Corporation of America

INDUSTRIAL LUNCHEON SPEAKER

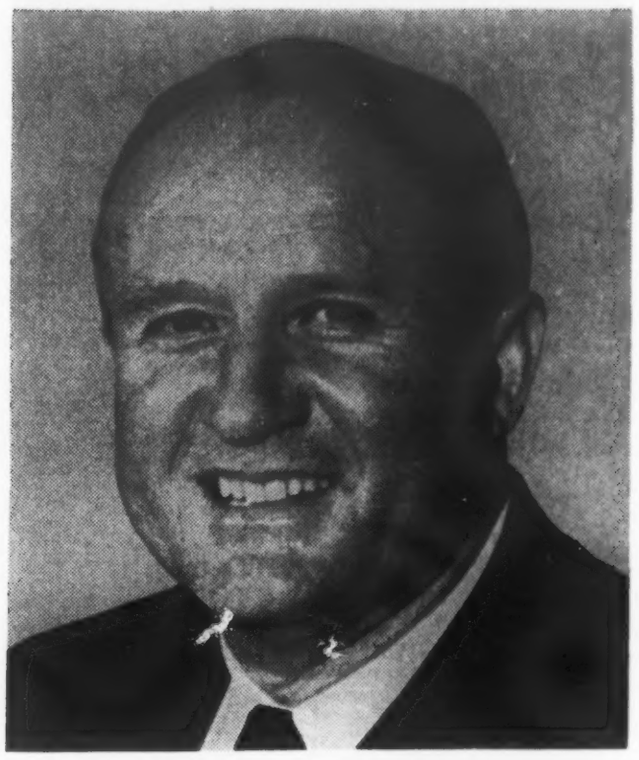
To be introduced by Vice Adm. Murrey Royar, The National Co.

For his outstanding accomplishments in industry and defense, J. Carlton Ward, President of the Vitro Corporation of America, has received renowned recognition seldom equalled by one so dedicated to the advancement of our economic, industrial and defense welfare.

From 1914 to the present, his contributions to our American way of life have been nothing short of miraculous. As a statesman, educator, industrialist, government consultant, business executive and director of numerous activities, Mr. Ward has always found time to give unselfishly of his time to assist his fellowman both on the international and national scene.

Space does not permit the listing of all of his accomplishments and affiliations. Educationally, he is a graduate (M.E. degree) of Cornell University. Industrially, he has achieved marked success in fifteen diverse fields of American industry. To name a few: production engineering, atomic materials, aircraft engines, electronics and nuclear propulsion.

Enthusiastically busy at all times, Mr. Ward is to be admired for his continuing work in engineering, scientific research and national preparedness.



WILFRED B. GOULETT

Captain, USN (Ret.)
Executive Vice President, AFCEA
CONVENTION CHAIRMAN

Welcome to AFCEA's Thirteenth Annual Convention and Exhibit! We of the Committee predict that this will be AFCEA's very best Convention, and opine that all of you AFCEANS and other readers will be cheating yourself if you don't attend. You certainly don't want to be cheated—so *do* come.

As in the development of our 1958 Convention Theme, our 1959 slogan, "Communications, Electronics, Photography—Hallmarks of Outer Space," came from the fertile mind of Colonel Sparky Baird, Editor, SIGNAL Magazine. What other words can show more fittingly that AFCEA marches in tune with the times!

You will have fun at AFCEA's Convention, and you'll benefit from examination of the skillfully arranged quality exhibits representing AFCEA's three fields, Communications, Electronics and Photography; from attendance at any or all of the six Panel Discussions; from going to the Banquet, Buffet Supper and Entertainment, and the Keynote and Industrial Luncheons on the first and last days, respectively; from the tour to Fort Meade's Missile Master Center, and from meeting old friends and new and wonderful people.

With your wife and family you can use AFCEA's Convention as an A-1 excuse for working in a vacation in our Nation's Capital. Please show these greetings and other Convention notices to the ladies, who are cordially asked to come along and enjoy the special program arranged for them.

As usual, the Convention will be noteworthy in terms of the conclaves of the National Council and Board of Directors, of the National Executive Committee, and of the Chapter Presidents. These meetings consider the regular annual business matters of the Association, including the election of a new National President and other officers and of at least eight new Directors. A sparkling gathering, the Chapter Presidents' meeting on June 3 will provide unexcelled opportunities for our extremely important "leaders in the field" to air their opinions and take a hand in the management of AFCEAN affairs.

Speaking for National Headquarters and for the Convention Committee, I would like to thank President Furth, here in print, for his zeal and immense contributions to the Association, and to wish him continued success as a Vice President of the International Telephone and Telegraph Company. As is usual with him, he gave a lot of himself to the exacting billet of National President.

Again, as spokesman for the Convention Committee, I invite you to AFCEA's major yearly event for the full three days.

Yours for a superlative Convention,
W. B. (BILL) GOULETT

1959 AFCEA CONVENTION COMMITTEE

Keynote Luncheon
J. F. Whitehead
Nems-Clarke Company

Tours & Transportation
Ralph I. Cole
Melpar, Incorporated

Industrial Luncheon
E. A. Corey
Capitol Radio Engineering Institute

Epicure
Frank Clarke
Texas Instruments, Incorporated

Entertainment
W. D. Myers
Cook Electric Company

Publicity
Thomas E. Gootée
OCSigO, USA

Invitations
Julia Godfrey
National Headquarters

Exhibits
W. C. Copp
William C. Copp and Associates

Buffet and Reception
John Gilbarte
Admiral Corporation

Reception and Hospitality
Murrey Royar
The National Company, Inc.
G. L. McGowen
Texas Instruments, Incorporated

Panels
Dwight M. Agnew

Banquet and Reception
Murray Block
F. W. McDermott
International Tel. & Tel Corp.

Ladies Activities
Elizabeth J. Goulett

Treasurer
Thomas B. Jacocks
General Electric Company
Frank Martins
National Headquarters

Advisory Group

Percy G. Black
General Telephone Service Corp.

Millard C. Richmond
Western Electric Company

Francis H. Engel
Radio Corporation of America

John R. O'Brien
Hoffman Laboratories

W. J. BAIRD
Editor

TO seek out ways and means to maintain that delicate balance between war and peace is but one of the reasons why the Armed Forces Communications and Electronics Association is meeting in Washington, D. C., for its 13th Annual Convention. This year's Convention theme, "Communications, Electronics and Photography—Hallmarks of Outer Space," carries the connotation that the members of the Association who make these areas of American industry their primary business can inscribe indelibly their aims and objectives in outer space, thereby swinging the pendulum of decision toward more peaceful pursuits. Whether we do this by words or deeds matters not too greatly. The main point is that we have a full realization that we cannot afford the luxury of complete preoccupation with our own affairs to the exclusion of national responsibilities.

As we assemble on June 3, 4 and 5, 1959, another question, and probably the most important one confronting us, is whether the world will strive for peace through continued economic and scientific advancements or succumb to war. The decision of war may or may not be one of choice. Within the family of nations, the alternative may be an acceptance of a decision to commit international suicide through nuclear conquest or as a result of a miscalculated incident, plunge humanity into catastrophic consequences. Time and logic have proven that a miscalculated incident is the more dominant causative agent in the present world situation. In the short span of a few years we have come to realize that nuclear weapons with their ravaging action cannot themselves dictate a national decision. Neither can nuclear weapons be the decisive instrument for political negotiations or international blackmail. In today's arena of survival, democracies and dictatorships are equally subjected to suicidal folly. Since man is the planner and ruler of his own destiny, he has in this day created a situation where he no longer holds the power to regulate the results of his decision. For to seek atomic victory is to provide the blueprint for man's own destruction. While the probability of a third world war (and possibly a final world conflict) cannot be discounted, certain happenings during the past year based on elements of cooperation among the world community of nations add up to a stronger possibility for peace. "Peace is one luxury in our time we cannot enjoy piecemeal."*

On the economic scene, significant progress has been made in Western Europe. The economic cooperation of Western European nations has aided materially in strengthening the world security situation. Also adding to the international cooperation movement for peace have been the conferences for the peaceful uses of the atom and the acquisition and interchange of scientific data in the International Geophysical Year. Not to be overlooked are the cultural exchanges between nations which are destined to develop a greater understanding and a deeper appreciation of the domestic outlook of the people involved. There have been many other events worthy of mention but the most startling has been man's desire to explore the unknown of outer space. This has been a demonstration of his adventurous spirit with emphasis on his desire for knowledge rather than the collection and dissemination of scientific data for destructive purposes.

In this era of industrial, economic and social revolution, there is much hope so long as man continues to build a solid structure of understanding and cooperation which cannot help but open doors previously closed to negotiation. If we learn to accept with sincerity those things which we cannot change and change those things which are within our province to change, then our future will be established on a foundation as strong as the Rock of Gibraltar.

Finally, we have but to reflect momentarily to appreciate the potential value of the United Nations during the past year. Through positive action it succeeded in extinguishing the sparks of conflict which could have provoked an atomic holocaust destroying civilization like a consuming flame, a reassuring demonstration of the value of public opinion.

Our one best chance to remain strong and avoid war will depend as much as anything else on our continued progress in communications, electronics and photography. There is no better place to discuss problems inherent in these rapidly expanding industry areas than at the annual Convention.

It is our primary responsibility not only to accept the economic, industrial and scientific challenges on all fronts, but through prodigious effort provide knowledge and understanding to strengthen our research, development and technology so that our industrial organizations can act quickly to preserve our heritage. Our business is to come up with answers —ways and means to benefit mankind. What we say and what we learn will go a long way toward a peaceful future.

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*_World Community Reporter_, International Newspaper.

service communicators send greetings

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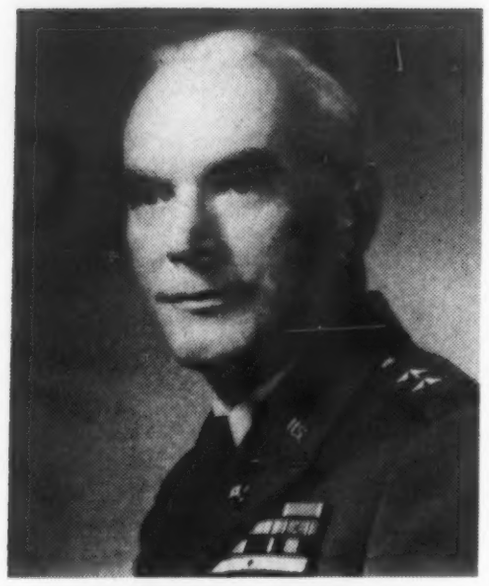

Maj. Gen. R. T. Nelson
Chief Signal Officer, USA

The scientific and technological accomplishments of our nation in the exploration and conquest of outer space are made possible only through the most advanced and sophisticated applications of communications, electronics, and photography. This triumvirate assures tremendous strides forward in our search for knowledge and the peaceful development of the great dimensions of vastness that surround our globe. Only through communications, electronics, and photography are we able to probe, chart, and ultimately control for peaceful purposes the vast regions of outer space. Here, as in so many related fields of endeavor, the joint military-industry partnership—which is the backbone of AFCEA—provides the resources, the experience, and the determination to continue to pioneer in this, the Space Age.

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The Space Era has imposed demands on the communications-electronics family of American scientists, researchers, planners and developers, both civilian and military, that are unsurpassed in U. S. technological history.

The combination of our industry and our Armed Forces is responding to the latest challenge with rapid breakthroughs which are tantamount to a calendar of major events as, almost monthly, communications-electronics horizons are pushed farther into Space.

The Armed Forces Communications and Electronics Association has not played a small role in these accomplishments. Not the least important of AFCEA's contributions is leadership to maintain the Nation's technological supremacy now being vigorously contested in a troubled world.

The contest has spread from Earth to include Space. A big factor in ultimate victory for the free world, under America's free economy, is the complete cooperation of free men in and out of uniform, thinking individually and working together in fierce competition with the communist tyranny.

The Armed Forces Communications and Electronics Association, aware of the great objective of winning this competition, is a valuable instrumentality for building America's strength.

RAdm. Frank Virden, USN
Director, Naval Communications

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Maj. Gen. Harold W. Grant, USAF
Director, Communications-Electronics

For the past decade the Armed Forces Communications and Electronics Association has played a leading role in the union of military and civilians into a communications-electronics team. This team has successfully developed capabilities of unparalleled dimensions in the fields of communications, electronics and photography. This development comes at a time when unprecedented demands are being made on industry-military resources to satisfy not only military requirements but man's thirst for knowledge about the unknown elements in Space.

The theme "Communications-Electronics and Photography—Hallmarks of Outer Space," seems particularly appropriate. It symbolizes the place to which the communications, electronics and photographic arts have risen. We are unable to rest on our laurels and must constantly strive to satisfy the ever increasing technological demands.

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AFCEA NATIONAL CONVENTION PROGRAM

- 80 Exhibitors
- 130 Exhibit Units
- 6 Panel Discussions
- Trip to Ft. Meade, Maryland
- 6 Important Social Events
- Special Program for Ladies

PROGRAM OF EVENTS

Wednesday, June 3rd

9:00 AM—**Chapter Presidents**
Caribar Room

9:00 AM to 11:30 AM—**Panel Discussion — Modern Concepts of Space Communications**
Moderator: Rear Admiral John E. Clark, USN, Deputy Director, ARPA
(To be introduced by RAdm. Frank Virden, USN, Director, Naval Communications)
Sheraton Hall

12:30 PM—**Keynote Luncheon**
Speaker: General Curtis E. LeMay, Vice Chief of Staff, USAF
Sheraton Hall

2:30 PM to 5:00 PM—**Panel Discussion — Space Tracking**
Moderator: Colonel George P. Sampson, Chief, Army Communications Service Div., OCSigO
(To be introduced by Brig. Gen. Earle Cook, USA, Chief of R and D Div., OCSigO)
Sheraton Hall

2:30 PM—**Chapter Presidents**
Caribar Room

6:30 PM—**Reception**
Florentine Room

7:45 PM—**Buffet Supper**
Sheraton Hall

Exhibits: 11:00 AM—7:00 PM

Thursday, June 4th

9:00 AM—**Council & Directors**
Caribar Room

9:00 AM to 11:30 AM—**Panel Discussion — Scientific Applications of Photography**
Moderator: Rear Admiral Robert S. Quackenbush, Jr., Polaroid Corp.
(To be introduced by RAdm. D. M. Agnew, USN Ret.)
Sheraton Hall

12:00 Noon — 1:00 PM — 2:00 PM
Buses leave for Tour of Fort Meade Missile Master Center

2:30 PM to 5:00 PM—**Panel Discussion — Educational Programs in Electronics**
Moderator: Dr. A. B. Butts, Educational Advisor, Office of Adjutant General, Department of the Army
(To be introduced by RAdm. D. M. Agnew, USN Ret.)
Sheraton Hall

6:30 PM—**Reception**
Florentine Room

7:45 PM—**Banquet**
Speaker: Governor Leo A. Hoegh, Director of Civil and Defense Mobilization
Sheraton Hall

Exhibits: 11:00 AM—7:00 PM

Friday, June 5th

9:00 AM to 11:30 AM—**Panel Discussion — Military & Industrial Aspects of R & D Management**
Moderator: James M. Bridges, Director of Electronics, Office of Secretary of Defense, Research and Engineering
(To be introduced by Maj. Gen. Harold Grant, USAF, Director, C-E)
Sheraton Hall

12:30 PM—**Industrial Luncheon**
Speaker: J. Carlton Ward, Jr., President, Vitro Corporation of America
Sheraton Hall

2:30 PM to 5:00 PM—**Panel Discussion — Optimum Combination of Man and Machine for Maximum Reliability in Space Travel**
Moderator: C. R. Knight, Director, ARINC Research Corporation
(To be introduced by RAdm. D. M. Agnew, USN Ret.)
Sheraton Hall

Exhibits: 11:00 AM—5:00 PM

FOR THE LADIES

Mrs. Elizabeth J. Goulett
Chairman, Ladies Activities

Wednesday, June 3rd

10:00 AM—Assemble in the Madison Room for a "get acquainted hour" and review of plans

1:30 PM—Assemble in the Madison Room

2:00 PM—Bus leaves for specially conducted tour of 3 embassies

6:30 PM—RECEPTION and BUFFET SUPPER
Sheraton Hall

Thursday, June 4th

9:00 AM—Assemble in the Madison Room

9:30 AM—Bus leaves for Wilson Line Pier

10:00 AM—Boat leaves for Mount Vernon

11:15 AM—Boat arrives at Mount Vernon
Tour of house and gardens and tomb of George Washington

12:15 PM—Luncheon served

1:15 PM—Bus leaves for tour of Woodlawn Plantation

2:15 PM—Bus leaves for Gunston Hall

3:15 PM—Bus returns to hotel

Note: Tour to Ft. Meade with the men is an optional event.

6:30 PM—RECEPTION and BANQUET
Sheraton Hall

Friday, June 5th

9:00 AM—Assemble in Madison Room

9:30 AM—Bus leaves for specially conducted tours of the Mosque, Washington National Cathedral and Franciscan Monastery

12:30 PM—Return to hotel

FOR LISTING OF EXHIBITS SEE PAGE 19

RADM. JOHN E. CLARK, USN
Deputy Director, ARPA

COL. GEORGE P. SAMPSON, USA
Chief, Army Communications
Service Div., OCSigO

RADM. R. S. QUACKENBUSH, JR.
Polaroid Corporation,
Engineering Division

DR. A. B. BUTTS
Educational Advisor, AGO-DOA

MR. JAMES M. BRIDGES
Director of Electronics,
OSDR&E

MR. C. R. KNIGHT
Director, ARINC Research
Corporation

Panel Moderators

Wednesday, June 3rd

9:00 - 11:30 ***Modern Concepts of Space Communications***

PANEL MEMBERS:

Dr. E. Rectin, Jet Propulsion Laboratories; Dr. S. Batdorf, Advanced Research Projects Agency; Mr. L. Jaffee, National Aeronautics and Space Administration; Dr. R. M. Paige, Naval Research Laboratory; Dr. N. Snyder, Advanced Research Projects Agency.

2:30 - 5:00 ***Space Tracking***

PANEL MEMBERS:

Mr. R. L. Easton, Space Surveillance Branch, Naval Research Laboratory; Col. G. Gould, Deputy Director Commander of Weapons Systems for Electronics, Andrews Air Force Base; Cdr. D. C. Holmes, Advanced Research Projects Agency; Dr. J. A. Hynek, Smithsonian Astrophysical Laboratories; Mr. J. T. Mengel, Beltsville Space Center, National Aeronautics and Space Administration; Dr. H. L. Richter, Jr., Jet Propulsion Laboratories; Dr. H. G. Weiss, Lincoln Laboratories, Massachusetts Institute of Technology; Dr. H. Ziegler, Chief, Astroelectronics Div., U. S. Army Research and Development Laboratories.

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Thursday, June 4th

9:00 - 11:30 ***Scientific Applications of Photography***

PANEL MEMBERS:

Mr. E. B. Woodford, ARDC, Wright-Patterson Air Force Base; Lt. G. M. Brewer, USN, Navy Photographic Center; Lt. Col. N. Gray, USA, Combat Surveillance Agency; Mr. D. S. Connor, Manager, Guidance Systems Engineering, Chicago Aerial Industries, Inc.

2:30 - 5:00 ***Educational Programs in Electronics***

PANEL MEMBERS:

Mr. P. Reisz, Student, Northeastern University; Mr. A. Taul, U. S. Navy Bureau of Personnel, Electronics Training; Mr. L. M. Upchurch, Dean, Capitol Radio Engineering Institute.

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Friday, June 5th

9:00 - 11:30 ***Military and Industrial Aspects of R&D Management***

PANEL MEMBERS:

Dr. H. A. Wilcox, Deputy Director, Defense Research and Engineering, Department of Defense; Mr. G. O. Pehrson, Director, Plans and Programs, Special Projects Div., U. S. Navy Bureau of Ordnance (Polaris); Mr. J. D. McLean, President, Hoffman Laboratories; Mr. R. J. Brown, Director, Sales, Heavy Military Electronics Dept., General Electric Co.

2:30 - 5:00 ***Optimum Combination of Man and Machine for Maximum Reliability in Space Travel***

PANEL MEMBERS:

Dr. Franklin Taylor, Naval Research Laboratory; Mr. J. W. Senders, Minneapolis-Honeywell Regulator Co.; Mr. H. Eppenstein, Reliability Organization, Convair, Astronautics Div.; Dr. G. C. Wright; Mr. M. A. McLennan, Aero Medical Laboratories, Wright Air and Development Center.

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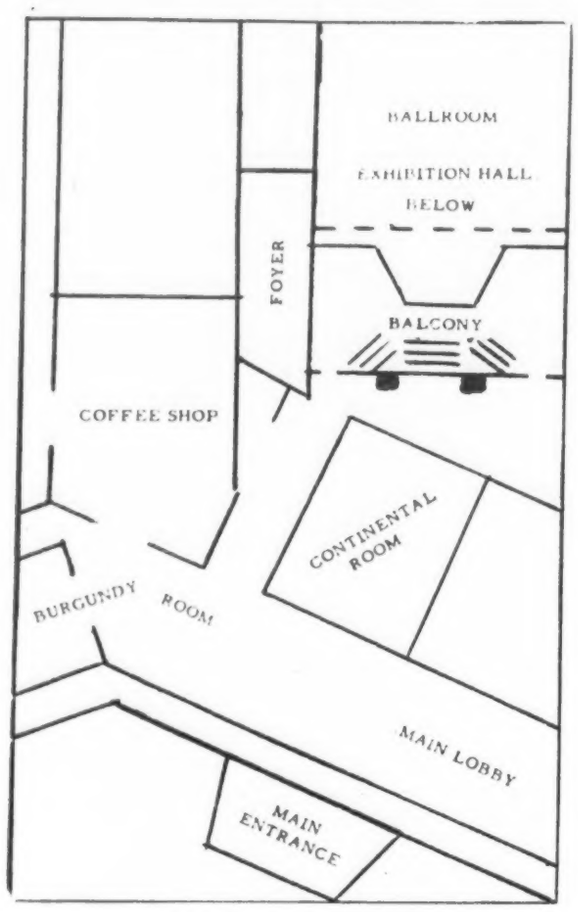
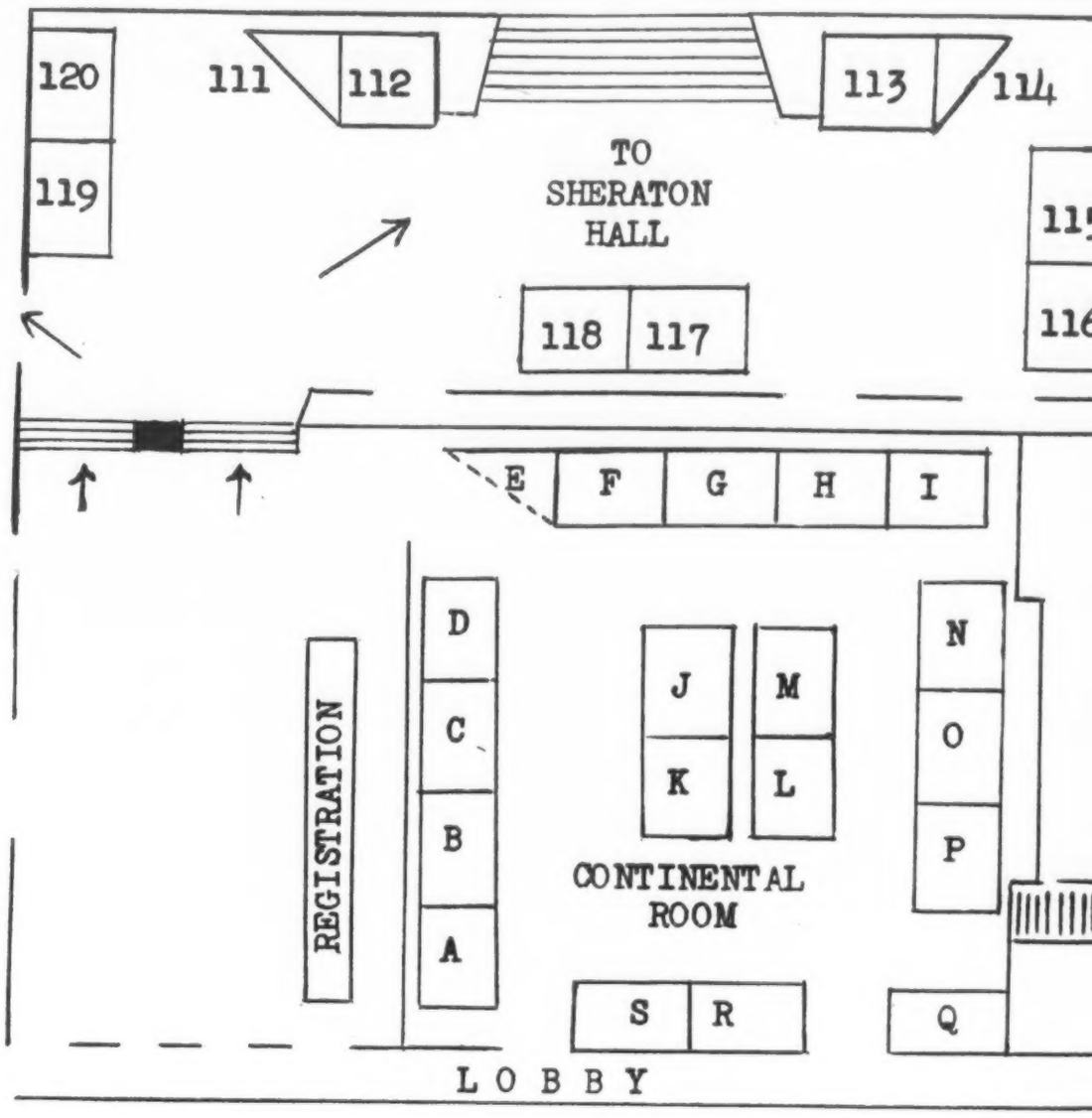
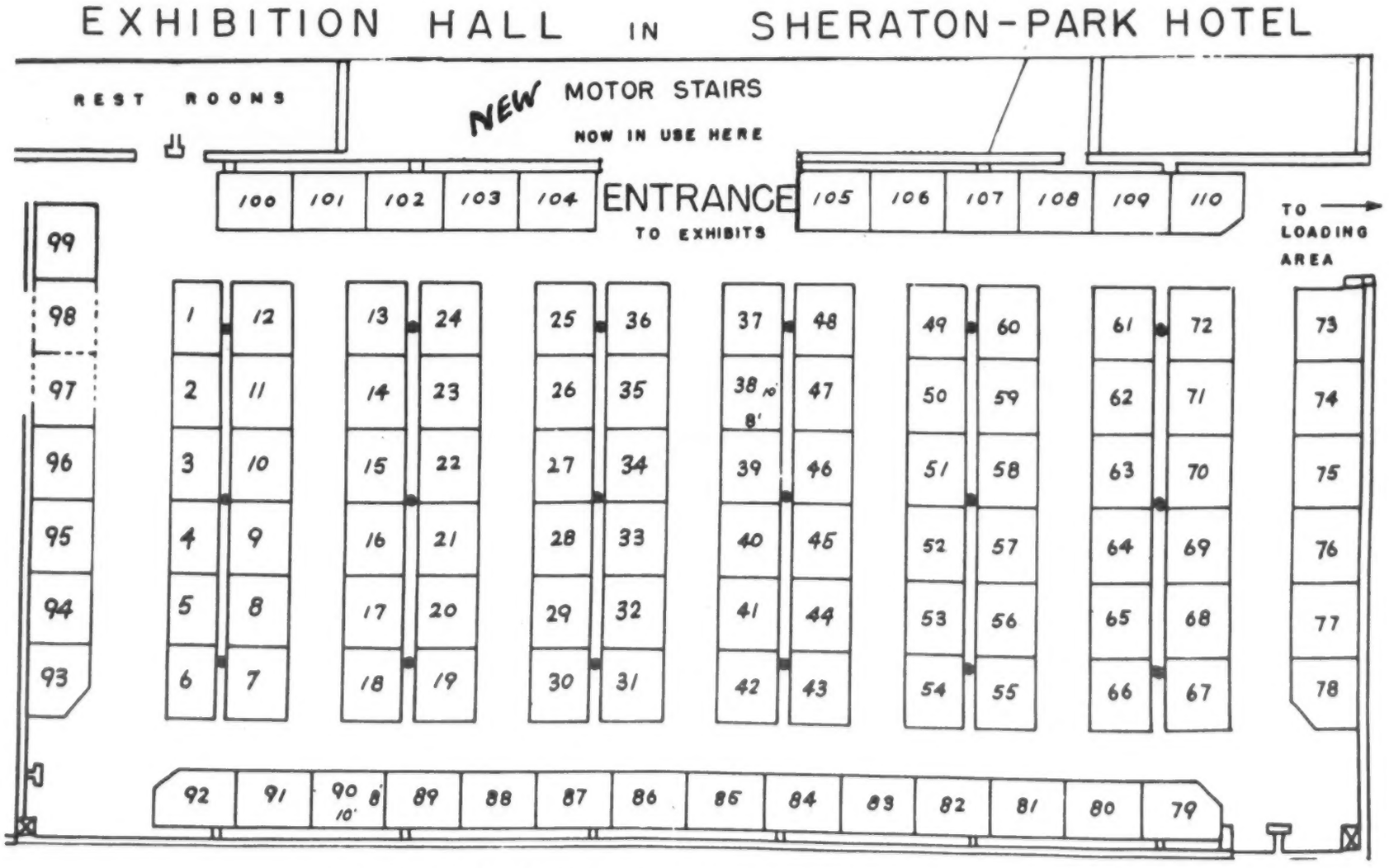


General Map

All exhibitors will be pleased to answer your questions and supply any information desired.





Ampex Videotape Cruiser

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EXHIBIT MANAGEMENT

WILLIAM C. COPP & ASSOCIATES

72 West 45th St., New York 36, N. Y. • Murray Hill 2-6606

Adler Electronics, Inc. ***Booth #F***
1 Le Fevre Lane, New Rochelle, N. Y.

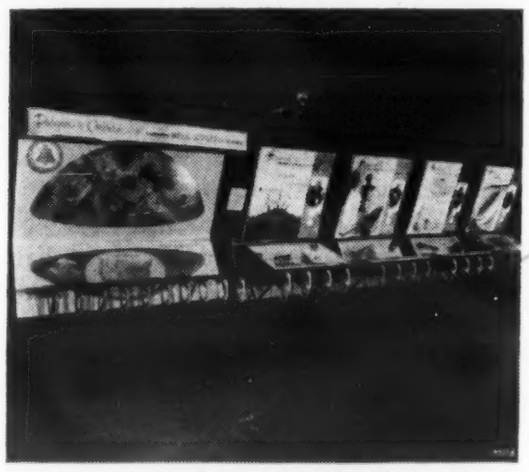
• Alfred Strogoff, Alwyn Carty, Jerome Friedman, Harold Kaye, Sheldon Newberger, Emanuel Strunin

The AN/TSC-16 Communications Central which provides more voice and teletype channels than ever before available in a ground-air transportable system will be on exhibit in front of the Sheraton-Park Hotel—built for the US Army Signal Corps. Compact plug-in, frequency conversion units, which permit military VHF equipment to operate on UHF channels also will be shown.

American Telephone & Telegraph Co. ***Booths #102, 103, 104***
195 Broadway, New York 7, N. Y.

• J. A. Osterman, G. D. Montgomery

Exhibit reveals the vital part of Bell System communications in the defense of our nation and the importance of scientific research at Bell Telephone Laboratories.



Progress in Communications Through Bell System Science

► **See ad on page 2** ◄

Ampex Corp. ***Exhibit Court***
934 Charter St., Redwood City, Calif.

• Warren Anderson, Bob Day, Phil Thornton

Ampex "Videotape" Cruiser, comprising an Ampex VR-1000 Videotape recorder, two image-orthicon television cameras, video and audio monitors, an independent power source and necessary control equipment to provide a completely self-contained, full mobile facility for recording and playback of television programming anywhere in the world. (Located in exhibit court outside of Exhibition Hall.) See map p. 18.

Applied Research, Inc. ***Booth #J***
76 S. Bayles Ave., Port Washington, N. Y.

• A. M. Scandurra, N. M. Poulos, M. Dolin, C. G. Costas

An operating UHF broadband multichannel receiving system featuring novel approaches to design of communications, intercept systems, bandpass filters, UHF converters, UHF broadband amplifiers, variable attenuators, multicouplers, multiplexers, type BNC, TNC, N fixed pad attenuators and terminations.

ARINC Research Corp. ***Booth #97***
1700 K St., N. W., Washington, D. C.

• W. von Alven, R. T. Williams, D. C. King, H. J. Kennedy, C. L. Noelcke, J. C. Burns, J. A. Scanga, D. C. Kochendarfer

An independent research and consulting organization, specializing in the analysis of parts, components and systems, for improved reliability, producibility and maintainability — Reliability Engineering; Application and Specification Engineering; Laboratory and Field Engineering Services.

Assembly Products, Inc. ***Booth #29***
75 Wilson Mills Rd., Chesterland, Ohio

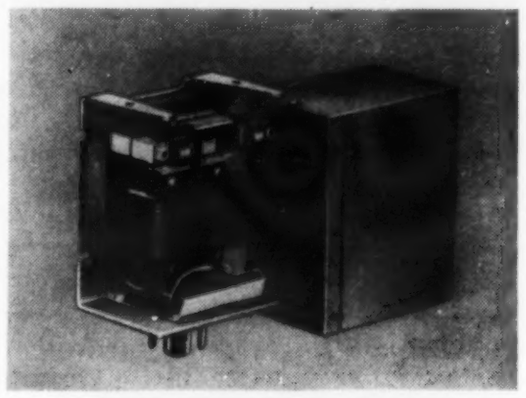
• Robert Pugsley, Lloyd Rowe, Tom Swiler, Lou Issel

Exhibit features API meter-relays, special controls, panel meters and Metronix electronic voltmeters. Meter-relays control any variable measurable with a transducer. Newest model is non-indicating with adjustable contacts.

Automatic Electric Sales Corp. ***Booth #61***
Northlake, Ill.

• E. E. McCorkle, H. B. Bittner, V. P. Costello

Control components for military and industrial applications; pre-wired, modular packaged control sub-assemblies; complete systems for control or communications; research and development in communications and control techniques.



Type 204, Series PTW Polar Relay

► **See ad on page 48** ◄

Automatic Telephone & Electric Co. Ltd. ***Booths #55, 56***
Strowger House, 8 Arundel St., London, W.C. 2, England

• H. R. A. Wood, W. Carsbury, R. Atherton

The latest developments in telegraph distortion measuring equipment, VHF radio-telephone links and microwave channelling are shown. New products displayed include a crystal controlled chronometer and thermally compensated crystal oscillators.

Bendix Aviation Corp., Bendix-Pacific Div. ***Booth #64***
11600 Sherman Way, N. Hollywood, Calif.

• J.R. Harkness, H. D. Wilkinson, N. A. Garretty, J. Siltanen, J. Famiietti, D. E. Wassall

Advanced designs of digital data handling equipment for ground communications; high resolution helicopter radar systems; terrain avoidance systems; the Decca navigator system. First public showing for much of this equipment.

► **See ad on page 7** ◄

Bendix Radio Div. ***Booths #62, 63***
Baltimore 4, Maryland

• W. W. Price, A. A. Fiedler, E. A. King, Tom Jones, Tom Schillo, Clifford Burton, Henry Woodson, James Jarrett, James Pearce, Myron Whitney

Inertialess array 3-D Radar; Air Defense Radar; Air Traffic Control Radar; ECCM Devices; Ground/Air Communications; Airborne Radio Navigation; Twilight Scatter Communications and Detection; Air/Ground Data Links; Integrated Aircraft Radio Controls; Space Communications; Space Vehicle Tracking; Automatic Checkout Systems; Training Devices; Field Support.

► See ad on page 7 ◄

Berg. Hedstrom & Co., Inc. ***Booth #16***

See: Geodimeter Co., The

Bomac Labs., Inc. ***Booths #77, 78***
Salem Road, Beverly, Mass.

• H. C. Booth, H. J. McCarthy, R. L. Broderick, E. D. Benson

Complete line of TR, ATR, Pre TR Gas Switching Tubes, Shutter Tubes, Magnetrons, Reflex Klystrons, Reference Cavities, Coaxial Monoplexers and Duplexers. Pressurizing Windows, Silicon Diodes and Surge Protectors. Introducing a complete line of crystal protectors and high-low temperature TR tubes, extended temperature tubes.

► See ad on 4th Cover ◄

Capitol Radio Engineering Institute ***Booth #12***
3224 16th St., N. W., Washington, D. C.

• K. O. Bathke, E. A. Corey, H. I. Metz, J. R. Kelley, Kenneth Gould, Charles DeVore

CREI Home Study courses in Radio, Electronic, Aeronautical, Television, Radar & Servo Engineering Technology and Management. CREI Atomics Course in Nuclear Engineering Technology.

Welcome AFCEA to Washington

► See ad on page 99 ◄

Central Electronics Corp., a subsidiary of Zenith Radio Corp. ***Booths #3, 4***

Single sideband radio transmitters.

CGS Labs., Inc. ***Booths #17, 18***
Routes 7 and 35, Ridgefield, Conn.

• M. L. Jackson, A. Winter, J. L. Gray, F. Grossman

INCREDUCTOR® Controllable Inductors
TRAK® Panoramic Receivers
TRAK Type 21 Multicouplers
TRAK Code Converters and Translators
Countermeasures Systems
CHECKMATE® Automatic Test Equipment

Collins Radio Co.
Booths #7, 8, 9, 10
855 35th St., N.E., Cedar Rapids, Ia.

Advanced design communication, navigation, flight control and data transmission equipment.

► See ad on page 103 ◄

Conference Book Service ***Booth #Q***
3209 Columbia Pike, Arlington 4, Va.

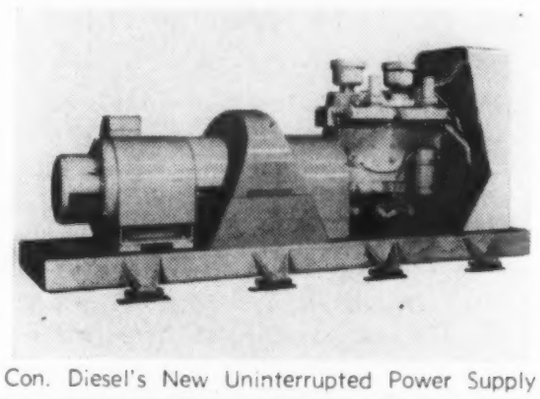
• R. L. Oshins, T. A. Moser, V. H. Moser

Exhibit of books and pamphlets in fields of pertinent interest to Convention participants.

Consolidated Diesel Electric Corp. ***Booth #53***
880 Canal St., Stamford, Conn.

• Howard Elakman, Frank Cesario, Jerry Friedman, M. J. Sullivan

New Uninterrupted Power Supply, which, in the event of line power failure, automatically restores full line voltage in 1.5 milliseconds.



Con. Diesel's New Uninterrupted Power Supply

► See ad on page 83 ◄

Dage Television Div., Thompson Ramo Wooldridge Inc. ***Booth #D***

(See: Thompson Ramo Wooldridge Inc.)

W. 10th St., Michigan City, Ind.

• W. E. Smith, S. T. Spangler, O. D. Page

Specialized television for all military applications including ground and air transmissions.

Portable Television Camera and Transmitter System

► See ads on pages 26, 107 ◄

Dictaphone Corp. ***Booth #101***
420 Lexington Ave., N. Y. 17, N. Y.

• L. A. Engel, J. Lethbridge, W. B. Sturtevant

Dictaphone dictating and recording equipment featuring: Time-Master dictation machine, Dictet portable recorder, multi-channel continuous recorders and Telecord network dictation systems.

Dyna Magnetic Devices, Inc., with subsidiary Guidance Controls Corp. ***Booth #110***
110 Duffy Ave., Hicksville, L. I., N. Y.

• G. J. Sebesta, A. J. Mellen, Jr., W. H. Niles, J. Brewster

Sub-miniature microphones and earphones; newly developed and patented electro magnetic clutch design for subminiature to type C-18; newly developed precision potentiometer giving the greatest linearity precision in a production run potentiometer.

► See ad in June issue ◄

Dynamics Corp. of America ***Booths #43, 44, 45, 46***

See: Eldico Electronics, Radio Engineering Labs., Reeves-Hoffman

Eldico Electronics, Div. Radio Engineering Labs., Inc. ***Booth #43***
29-01 Borden Ave., L. I. City, N. Y.

• Mike Kraus, Sam Bayer, Murray Gellman

Single Side Band Communications Equipment for Military, Commercial and Amateur.

► See ad on page 67 ◄

Electronic Communications, Inc. ***Booths #71, 72***
1501-72nd St., N., St. Petersburg, Fla.

• Leslie Spencer, Harvey Harrod

WHAT ECI MAKES: Electro-mechanical actuators for aircraft and missiles; radio transmitters and receivers; special equipment using digital techniques; data transmission systems; missile guidance equipment; communications sub-systems; underwater sound systems; control systems including servo apparatus; stabilization devices: analog computers; direction-finding navigational systems; aircraft seat belts; facsimile equipment for remote reproduction; high-performance motors; fuel pumps.

Federal Electric Corp., ITT Service, Associate of ITT Corp. ***Booths #83, 84, 85, 86, 87, 88***

See: International Telephone & Telegraph Corp.

Gates Radio Co. ***Booth #47***
123 Hampshire St., Quincy, Ill.

• L. J. Cervone, R. W. Kuhl

Communication equipment including the new 50 watt 4-channel single sideband transceiver, an FM multiplex subcarrier generator, an intercommunications amplifier, a totalizing recorder and special purpose equipment for missile tracking and positioning.

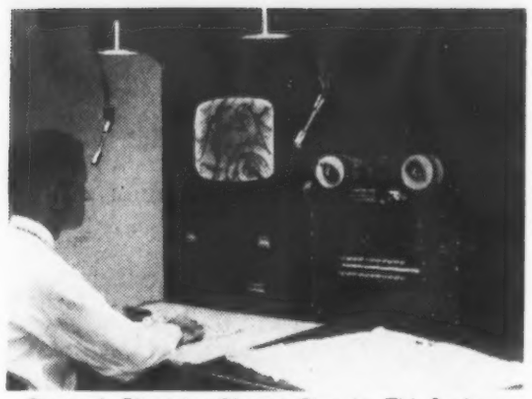
General Dynamics Corp. ***Booths #89, 90, 91, 92***

See: Stromberg-Carlson Co.

General Electric Co., Communication Products ***Booth #25***
Electronics Park, Syracuse, N. Y.

• D. O. Morgan, R. W. Franklin, C. J. Simon, C. W. Michaels

Closed circuit television system for weather briefing, instantly transmits clear high-resolution pictures of opaque or transparent weather charts, maps and drawings from a central weather office to remote locations.



General Electric Closed-Circuit TV System

► See ad on page 62 ◄

General Electric Co., Defense Systems Dept. ***Booths #26, 27, 34, 35***
Atlantic Bldg-120 W. Genesee St., Syracuse, N. Y.

• T. R. Gunnette, F. W. Kirby
The display of the Defense Systems Department, Headquarters, in Syracuse, N. Y., illustrates the capabilities of this unique new G.E. Department in Program Management of Prime Systems, Support Systems and Planning Studies.

► See ad on page 62 ◄

General Electric Co., Heavy Military Electronics Dept. ***Booth #36***
Syracuse, N. Y.

• R. J. Brown, C. E. Beard, J. R. Wescott, F. R. Prentice, N. R. Bibko
The Heavy Military Electronics Dept. features a broad capability and competence in the design and manufacture of defense electronics equipment—from the smallest components to the Free World's largest radar systems.

► See ad on page 62 ◄

General Electronic Labs., Inc. ***Booth #99***
195 Mass. Ave., Cambridge, Mass.

Telemetry transmitters and receivers, special communication electronic equipment.

General Precision Lab. Inc. ***Booths #73, 74***
63 Bedford Rd., Pleasantville, N. Y.

Airborne Navigation Systems; High Resolution Closed-Circuit Television Systems.

The Geodimeter Co., Div. of Berg, Hedstrom & Co., Inc. ***Booth #16***
1170 Broadway, New York 1, N. Y.

• J. C. Bass, Gustav Westerlund
The Model-4 GEODIMETER, measures distances in difficult terrain, over water or pavement, within an accuracy of 0.04 ft. from 50 ft. to 3 miles.

Georator Corp. ***Booth #E***
315 Tudor Lane, Manassas, Va.

• Shelley Krasnow, R. A. Prange, J. O. Payne, Jr.
Featuring "Nobrush" brushless generators and frequency converters—compact sources of dependable, rugged, maintenance-free high and low frequency power. R.F. disturbance totally eliminated.

Fred S. Gichner Iron Works, Inc. ***Booth #75***
1214-24th St., N. W., Washington 7, D. C.

• Henry Gichner, George Fulmer, David Gichner, D. A. Graham, D. E. Baus, Charles Sciors, Joseph Gichner
All-aluminum shelter for electronics equipment and other uses; rigidly tested; insulated; interior dimensions 76 inch cube; can be airborne, floated, road-hauled; available with wheeled "mobilizer" for transport over-the-road.

Granite State Machine Co., Inc. ***Booth #6***
124 Joliette St., Manchester, N. H.

• James Banker, George Tack, Joseph Cassidy
Antenna Control Systems consisting of directional antennas, control-indicator, magnetic amplifier; Antenna Tuning Groups consisting of tuner, control-monitor, coupler; dipole and fixed array antennas; radomes; multicouplers; synchro gear trains.

► See ad on page 119 ◄

Gray Manufacturing Co. ***Booth #98***
16 Arbor St., Hartford 1, Conn.

• Byron Burke, Richard Otto, James Kane, Daniel Bernard
Government and Industrial Sales Div. components for the electronics and communications industries — precision frequency meters, actuators for naval torpedoes, radar altimeters and telephone-telegraph equipment. Gray audograph advance design line of dictation instruments including the Key-Noter, Gray Key-Man telephone dictation and remote control dictation instruments.

Guidance Controls Corp. Booth #110
See: Dyna Magnetic Devices, Inc.

Hoffman Electronics Corp., Hoffman Labs. Div. ***Booth #48***
3740 S. Grand Ave., Los Angeles 7, Calif.

Systems management, navigation equipment (TACAN), space communications, solar power supplies for space vehicles.

► See ad on pages 30, 31 ◄

Institute of Radio Engineers ***Booth #M***
1 East 79th St., New York 21, N. Y.

• W. C. Copp, Lillian Petranek, John Spargo, Hugh Keays, Earl Pollins
Proceedings of the IRE, IRE DIRECTORY. Convention Report, Professional Group Transactions, Membership Information.

► See ad on page 117 ◄

International Telephone and Telegraph Corp.
Booths #83, 84, 85, 86, 87, 88
Divisions and Associates: Federal Electric Corp., ITT Federal Div.; ITT Labs.; Kellogg Switchboard and Supply Co.
Complete air and ground communication networks and other air navigation systems covering the entire field of flight with global capabilities, including research, development, engineering, manufacturing and field service.

► See ad on pages 38, 39 ◄

International Telephone & Telegraph Corp., Federal Electric Corp. ***Booths #83, 84, 85, 86, 87, 88***
621-71 Industrial Ave., Paramus, N. J.

• D. Storck, J. C. Ceva, R. A. Marshall
Serves the electronic and communication industry with over-all project management including siting, installing, tuning and testing, operating, maintaining, evaluating electronic equipments or systems, by providing training, technical publications, spare parts provisioning.

► See ad on pages 38, 39 ◄

International Telephone & Telegraph Corp., ITT Federal Div. ***Booths #83, 84, 85, 86, 87, 88***
100 Kingsland Rd., Clifton, N. J.

• F. D. Hartman
Complete facilities for the design, development and manufacture of complex airborne and ground electronic systems in the fields of: navigation, communications, identification, countermeasures, guided missiles and special devices.

► See ad on pages 38, 39 ◄

International Telephone & Telegraph Corp., ITT Labs. ***Booths #83, 84, 85, 86, 87, 88***
500 Washington Ave., Nutley, N. J.

• Cmdr. G. E. Howarth, E. J. Felesina, G. G. Kallman
Two important aids to future manned space travel—gas cell "atomic clock" accurate to ±1 second in 300 years, and the parametric "low-noise" amplifier for microwave communication, radar, telescopy and navigation systems; fast-access digital tape transport for computer and information storage systems; magnetostrictive delay lines; traveling wave tubes.

► See ad on pages 38, 39 ◄

International Telephone & Telegraph Corp., Div., Kellogg Switchboard & Supply Co. ***Booths #83, 84, 85, 86, 87, 88***
6650 S. Cicero Ave., Chicago, Ill.

• W. J. Caprata
Relays, impulse counters, crossbar switches and other components for industry. Engineering, manufacturing and installation facilities for any type industrial system requiring switching technique and experience.

► See ad on pages 38, 39 ◄

Itek Corp. ***Booths #R, S***
Cresent St., Waltham 54, Mass.

• A. J. Rosenbaum, R. M. Fleming
Military reconnaissance systems and graphic information handling systems for industry and the military resulting from a new integration of optics and electronics based on applications of communication theory.

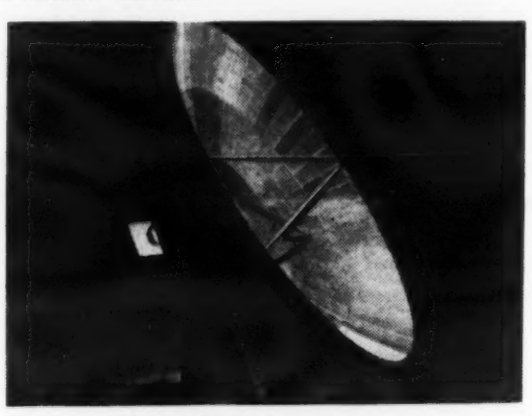
ITT Federal Div., ITT Corp.
Booths #83, 84, 85, 86, 87, 88
See: International Telephone & Telegraph Corp.

ITT Labs., ITT Corp.
Booths #83, 84, 85, 86, 87, 88
See: International Telephone & Telegraph Corp.

Jerrold Electronics Corp.
Booths #19, 20
15th & Lehigh, Philadelphia 32, Pa.
• Robert Vendeland, S. M. Kremer, Fred Lieberman, Harry Jackson, Bert Wolf, Joe Roseberry, Bill Miller, Jerry Hastings
Integrated closed-circuit systems for multiple points of source and distribution including training, briefing, surveillance and data systems (the planning, installation, operation and maintenance thereof).

Kellogg Switchboard & Supply Co., Div. of ITT Corp.
Booths #83, 84, 85, 86, 87, 88
See: International Telephone & Telegraph Corp.

D. S. Kennedy & Co. ***Booth #100***
155 King St., Cohasset, Mass.
• C. W. Creaser, K. H. Lippitt
Radio telescopes, manually operated tracker, action demonstration of long distance radar.



Kennedy Radio Telescope

► See ad on page 1 ◄

Kleinschmidt Labs., Inc., Div. of Smith-Corona Marchant Inc.
Booths #65, 66
Lake-Cook Road, Deerfield, Ill.
• Messrs. Strimling, Mitchell, Kearney, Geiser
Manufacturers' sale and lease of high-speed teleprinters, typing perforators, turn tape relay and fully automatic high-speed switching equipment.

► See ad on page 5 ◄

Lavoie Labs., Inc. ***Booth #52***
Matawam-Freehold Rd., Morganville, N. J.
• L. Lippert, R. James
Featuring new LA-302 Robotester, military test equipment—Frequency Meter LA70 (AN/URM-100) 0.0001% accuracy, Spectrum Analyzer AN/UPM-84.

Lenkurt Electric Co. ***Booths #37, 38***
1105 County Rd., San Carlos, Calif.
Microwave radio, telephone and telegraph carrier systems for Armed Forces communications.

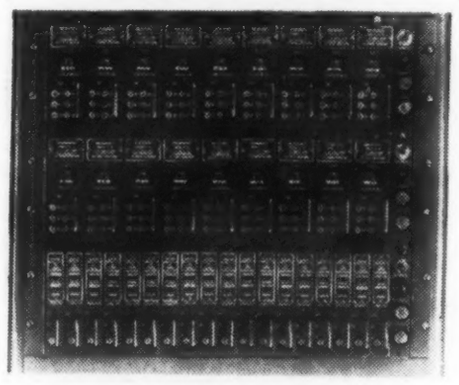
Litton Industries, Inc. ***Booth #76***
See: Westrex Corp.

Motorola Inc., Military Electronics Div.
Booths #69, 70
8201 E. McDowell Rd., Phoenix, Ariz.
Featuring advancements in the art of Solid State Electronics—Digital Calling and Single Side-band Airborne Communications Equipment—new transistorized miniature multichannel Command Receiver and IF Amplifiers.

► See ad on pages 34, 35 ◄

North Electric Co. ***Booths # 39, 40***
553 S. Market St., Galion, Ohio
• William Tucker, Fritz Gleim, T. W. Parsons, H. C. Ryon, Lloyd Bender, W. Wilson, C. A. Conry, C. V. Schuster, W. E. Reagan, H. H. Brewer, W. W. Crissinger
New system concept diorama exhibit featuring examples of the extensive communications, electronic and automatic control system capabilities of this 75-year-old telecommunications leader. Switching components are on display.

Northern Radio Co., Inc. ***Booth #82***
143-7 W. 22nd St., New York 11, N.Y.
• S. A. Barone, A. J. Odgers, F. C. Lambert, J. S. Harris, P. Flamholtz, M. Feinberg
Frequency shift terminal equipment including keyers, converters, twinplex, dual diversity receivers with highly stable variable master oscillators, AM & FS tone telegraph systems, regenerative repeater and Transistorized VF Carrier Telegraph Systems.

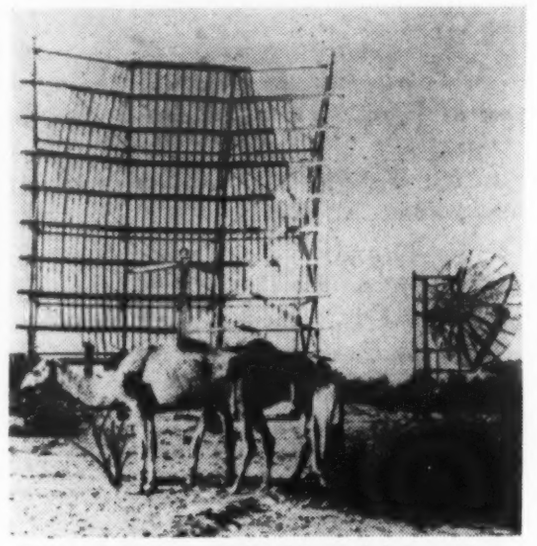


F.S. Tone-Keyer Converter

► See ad on page 112 ◄

Northrop Corp. ***Booth #31***
See: Page Communications Engineers, Inc.

Page Communications Engineers, Inc., a subsidiary of Northrop Corp.
Booth #31
710 14th St., N.W., Washington 5 D. C.
• H. H. Schenck, Edwin Dyke, Paul Rockwell, Ross Bateman, Gail Boggs, F. W. Donkin
Telecommunications engineering for missile systems and world-wide telecommunications networks; technical feasibility studies, site surveys, planning, research and development, design, installation, testing operation, and training.

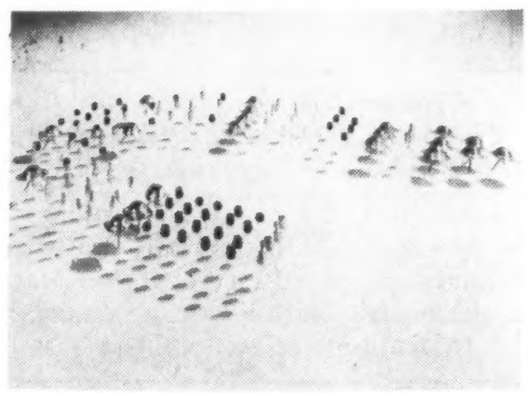


Tropo Antennas, Sirte, Libya, joint venture PCE—Hycon Page

► See ad on page 25 ◄

Phelps Dodge Copper Products Corp. ***Booth #11***
300 Park Ave., New York 22, N. Y.
• F. W. Lemly, H. M. Edwards, V. Clunet, C. Gray, F. W. De Turk, R. E. Plant, J. Buell
Complete line of Styroflex, Spirafil and Foamflex semi-flexible air dielectric coaxial cables, including high temperature air dielectric cables for use in missiles, rockets and other high temperature applications.

Philco Corp., Government & Industrial Div. ***Booths #13, 14, 15***
4700 Wissachickon, Philadelphia 44, Pa.
Transac S-2000 all transistor data processing system; global communication systems; earth satellite communications and tracking systems.



► See ads on pages 45, 97 ◄

Philco Corp., Lansdale Tube Co. Div. ***Booths #13, 14, 15***
Lansdale, Pa.
Philco's new low-cost medium power alloy junction transistors; complete transistor line; diode—X-band mixers;

low-noise dopplers; silicon K-band mixers; infrared detectors.

► See ads on pages 45, 97 ◄

Philco Corp., TechRep Div. ***Booths #13, 14, 15***
22nd & Lehigh Ave., Philadelphia 32, Pa.

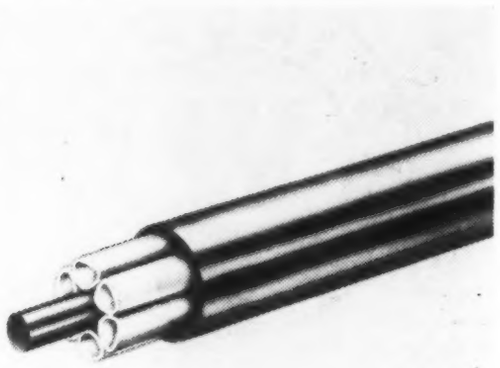
Field Engineering Services and Special Programs; Technical Publications; Correspondence Courses, and Training Material.

► See ads on pages 45, 97 ◄

Prodelin, Inc. ***Booth #54***
307 Bergen Ave., Kearny, N. J.

• L. A. Bondon, A. Haselman, R. F. Lewis, H. J. Eyerman, C. J. Watkins, G. A. Chadwick

Spir-o-line semi-flexible aluminum sheathed air dielectric cable and Spir-o-lok connectors; rigid copper and aluminum coaxial transmission line; parabolic antennas; VHF two-way mobile radio antennas.



Spir-o-Line semi-flexible aluminum cable

► See ad on page 36 ◄

Radiation, Inc. ***Booth #57***
Melbourne, Fla.

• C. J. Underwood, Jr., W. Cornelius

Telegraph Distortion Measuring Sets

► See ad on page 87 ◄

Radio Corporation of America, Broadcast & TV Div. ***Booths #67, 68***
Camden, N. J.

• J. Cassidy, P. Bergquist, A. F. Ingles, P. A. Greenmeyer

RCA "DATA-VISION"

Operating CC-TV display "DATA-VISION" for distributing weather data, information, briefings all over base. It's equipped with TV camera, lights, microphone, monitor, recorder and talk back.

► See ads on pages 28, 65, 89, 3rd Cover ◄

Radio Corporation of America, Defense Electronics Products ***Booths #49, 50, 51***
Camden, N. J.

• R. Cahill, G. R. Daggy, J. R. Dunn, C. M. Gilbert, W. S. Hahn, K. Harding, G. R. Rivers, T. F. Shannon, W. W. Shoaf, W. J. Zimmerman

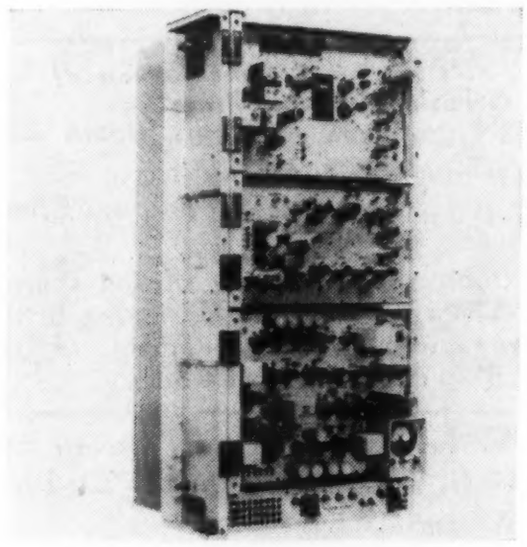
Institutional display covering RCA's latest military equipment and services.

► See ads on pages 28, 65, 89, 3rd Cover ◄

Radio Engineering Labs., Inc. ***Booths #44, 45***
29-01 Borden Ave., L. I. City, N. Y.

• F. A. Gunther, George Papamarcos, Harry Sadenwater

AN/FRC 39 Tropospheric Scatter Equipment; REL Type 863 Exciter; REL Type 864 Combining Receiver.



REL Type 864 Tropospheric Scatter Combining Receiver

► See ad on page 67 ◄

Rauland Corp., The, a subsidiary of Zenith Radio Corp. ***Booths #3, 4***

Transistor developments and cathode ray tubes.

Raytheon Manufacturing Co. ***Booths #21, 22, 23, 24***
Foundry Ave., Waltham 54, Mass.

• R. R. Andrews, D. J. Bailey, E. V. Sizer

Manufacturer of wide range military and commercial electronic products including complete HAWK and SPARROW III missile systems, FAA air-control radar, DEW-Line radar, navigational and bombing radar for the B-58, sonar for the Navy's atomic submarines and tubes which are used in more than 24 of the nation's missiles.

► See ad on page 115 ◄

Reeves-Hoffman, Div. Dynamics Corporation of America ***Booth #46***
145 Cherry St., Carlisle, Pa.

• C. M. Rahn, R. L. Van Gavree

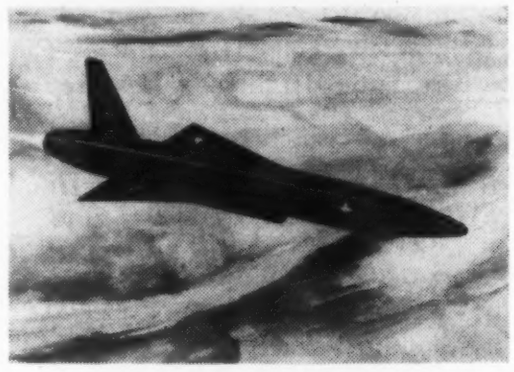
Quartz Crystal Units, Crystal Filters, Frequency Control Devices.

Remington Rand Univac, Div. of Sperry Rand Corp. ***Booths #93, 94, 95***
315 Fourth Ave., New York 10, N.Y.

Republic Aviation Corp. ***Booths #G, H, I***
Conklin St., Farmingdale, L. I., N. Y.

• Messrs. Murray, Wheat, Washburn, Mellor, Parker, Melrose, Brice, Shea, Simon, Speed, Sokol, Ryder, Curtis, Kamke, Patterson, Rice, Merewitz

AN/USD-4 "Swallow" Drone System; "PAD"—Phase Amplitude Detector; silver zinc and nickel cadmium—battery testers, battery chargers and capacity analyzers; "RACER"—Automatic Circuit Tester; an operable diorama showing 2 F-105 Thunderchief aircraft in flight.



AN/USD-4 "Swallow" Drone System

► See ad on pages 84, 85 ◄

Rixon Electronics, Inc. ***Booth #28***
2414 Reedie Dr., Silver Spring, Md.

• J. L. Hollis, C. J. Harrison, D. W. Perry, Marvin Frank

Custom Engineering & Manufacturing; Communications; Specialists in the field of transistor applications; 2500 Bit Transistorized Data Modem Equipment; Filter Networks; Delay Equalizer; Anti-Multipath Equipment, and Transistorized Relays.

► See ad on page 104 ◄

Smith-Corona Marchant Inc. ***Booths #65, 66***
See: Kleinschmidt Labs.

SoundScriber Corp., The ***Booth #K***
6 Middletown Ave., North Haven, Conn.

• Richard Emihmels, Ellis Butterfield

SoundScriber Monitor—24 hour continuous unattended tape recorder; SoundScriber Traveler—new flashlight battery operated transistorized portable; complete dictating machine line.

Specialty Engineering & Electronics Co. ***Booth #79***
79 Clifton Place, Brooklyn 38, N.Y.

• M. Cammer, R. Cammer, D. Alster, J. Ross

Automatic Weather Station—radiac &

dosimetry equipment including phosphate glass dosimeters, line & battery operated dosimeter readers and survey meter.

Sperry Rand Corp.
Booths #93, 94, 95

See: Remington Rand Univac

Stelma, Inc. ***Booth #58***
200 Henry St., Stamford, Conn.

Data telegraph electronic test automatic monitoring equipment related to telecommunications.

Stromberg-Carlson Co., Div. of General Dynamics Corp.
Booths #89, 90, 91, 92
100 Carlson Road, Rochester 3, N. Y.

• W. T. Lucas, W. H. Riley, E. T. Mueller, H. C. Sager, J. P. Vang, H. C. Sheve, J. W. Smith, R. F. Ames, Payne Johnson, Leo Murphy

SCATE — universal automatic test equipment for missiles, aircraft or ground electronic systems; TACAN Acceptance Tester; Air Traffic Control Equipment; Electronic Dial Telephone Switching System; High Speed Cathode Ray Tube Bright Display Unit.

► See ads on page 56, 57, 72 ◄

Sylvania Electronic Systems, A Div. of Sylvania Electric Products Inc.
Booths #59, 60
63 Second Ave., Waltham 54, Mass.

• J. W. Donoho, T. T. Hill, A. W. Christopher, W. H. Adams, E. G. Mason

Exhibit will feature research and development capabilities on data processing systems and related equipments and components. Products: MOBIDIC, Sylvania's Mobile Computer; UDOFT, Sylvania's Digital Flight Trainer.

► See ad on page 50 ◄

Technical Materiel Corp., The
Booths #32, 33
700 Fenimore Rd., Mamaroneck, N.Y.

High Frequency Communications Equipment: single sideband, AM, FS, CW transmitters, receivers, exciters, antenna multicouplers, variable frequency oscillators, RF patch panel assemblies, standing wave radio indicators, operating consoles.

► See ad on page 95 ◄

Teletype Corp. ***Booths #41, 42***
4100 Fullerton Ave., Chicago 39, Ill.

• E. J. Cook, R. A. Larsson, K. E. Wood, R. R. Bogdan, C. W. Burcky, D. R. Carmichael

Latest Teletype communications equipment including new light-weight teleprinter, 100 character-per-second tape punch and reader and Model 28 Automatic Send-Receive set with its choice of components will be displayed.

► See ad on page 8 ◄

Texas Instruments, Incorporated, Semiconductor-Components Div.
Booths #1, 2
2929 Cedar Springs, P. O. Box 312, Dallas 26, Texas

• G. L. McGowen, H. W. Seely, D. V. Ness, H. L. Mayer

Silicon transistors, diodes & rectifiers; germanium transistors, tantalum capacitors, precision resistors, "Sensitor" silicon resistors; radar, sonar, infrared systems; electronic, electromechanical, electromagnetic systems.

Thompson Ramo Wooldridge Inc.
Booths #A, B, C
1845 E. 30th St., Cleveland 14, Ohio
(See: Dage Television Div.)

Electronic Control Systems, Data processing Equipment and Microwave Equipment.

► See ad on page 26 ◄

Universal Instruments Corp.
Booth #5
139 E. Frederick St., Binghamton, N. Y.

• J. D. Ahearn, P. J. Wilson

Universal Lead Straightening and Taping Machine with Bulk Feed Attachment for Reeling Axial Lead Components. This is the first step in the process of automatic insertion of Printed Circuit Board Components.

U. S. Dept. of Labor, Bureau of Apprenticeship and Training
Booth #30
Washington 25, D. C.

• T. L. Weyn, M. M. Hanson, Elliott French

Exhibit shows services of the Bureau of Apprenticeship and Training in the promotion and development of the skills in the technical trades.

Webcor, Inc. ***Booth #96***
816 N. Kedzie Ave., Chicago 51, Ill.

Airborne data recorder-reproducer system, radio direction finder, antenna group, transistorized timers, controls, countermeasures equipment, keyer control group.

Western Electric Co., North Carolina Works ***Booths #N, O, P***
Lexington Rd., Winston-Salem, N. C.

• J. E. Culbertson, J. G. Minto

A graphic presentation of principles and techniques fundamental to the achievement of reliability in electronic weapons systems, from the initial concept through the life of the systems.

Western Union Telegraph Co.
Booths #80, 81
60 Hudson St., New York 13, N. Y.

• W. W. Alvis, W. H. Bowen, G. I. McFatter

Private Wire and Facsimile Services, demonstrating the USAF Weather Facsimile Network and letter-size Intrafax equipment.

► See ad on page 105 ◄

Westinghouse Electric Corp., Air Arm Div. ***Booths #107, 108, 109***
P. O. Box 746, Baltimore 3, Md.

• W. T. Duboc, G. W. Ehreke, W. D. Crawford, W. J. Reed, R. E. Fields, A. F. Young, Jr., J. R. Shober, R. A. Irwin

Advanced concepts in development, design and production of military airborne electronic systems for Bomber Defense, Fighter Armament, Missile Guidance, Reconnaissance, Space Travel and Systems Components.

► See ad on pages 58, 59 ◄

Westinghouse Electric Corp., Electronics Div. ***Booths #105, 106***
P. O. Box 1897, Baltimore 3, Md.

• Tom Cawley, Bill Hulse, Dick Beatty, Gary Waldorf, Dick Henry, Frank Ludemann

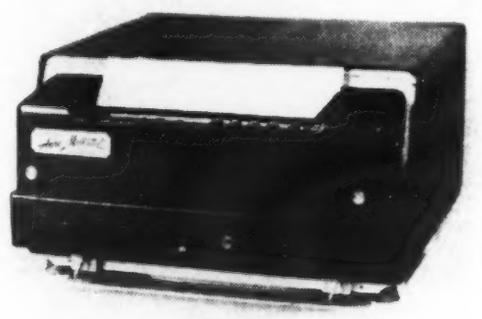
Three-Dimensional Radar. Electroluminescent Display, including an Alpha-Numeric Typewriter and CARDINAL, a Radio and Cable Digital Information Terminal, are three of the Military Systems featured.

► See ad on pages 58, 59 ◄

Westrex Corp., A Div. of Litton Industries, Inc. ***Booth #76***
111 Eighth Ave., New York 11, N. Y.

• H. P. Bechtold, Jr., Walter Neuser

Exhibit will feature the new 28 lb. "Aero-Monatel" LF frequency shift radio receiver and printer combination and also the Westrex 52 type SSB four-channel, remote-controlled receiver.



The Westrex Aero-Monatel LF Frequency Shift Radio Receiver

► See ads on pages 55, 113 ◄

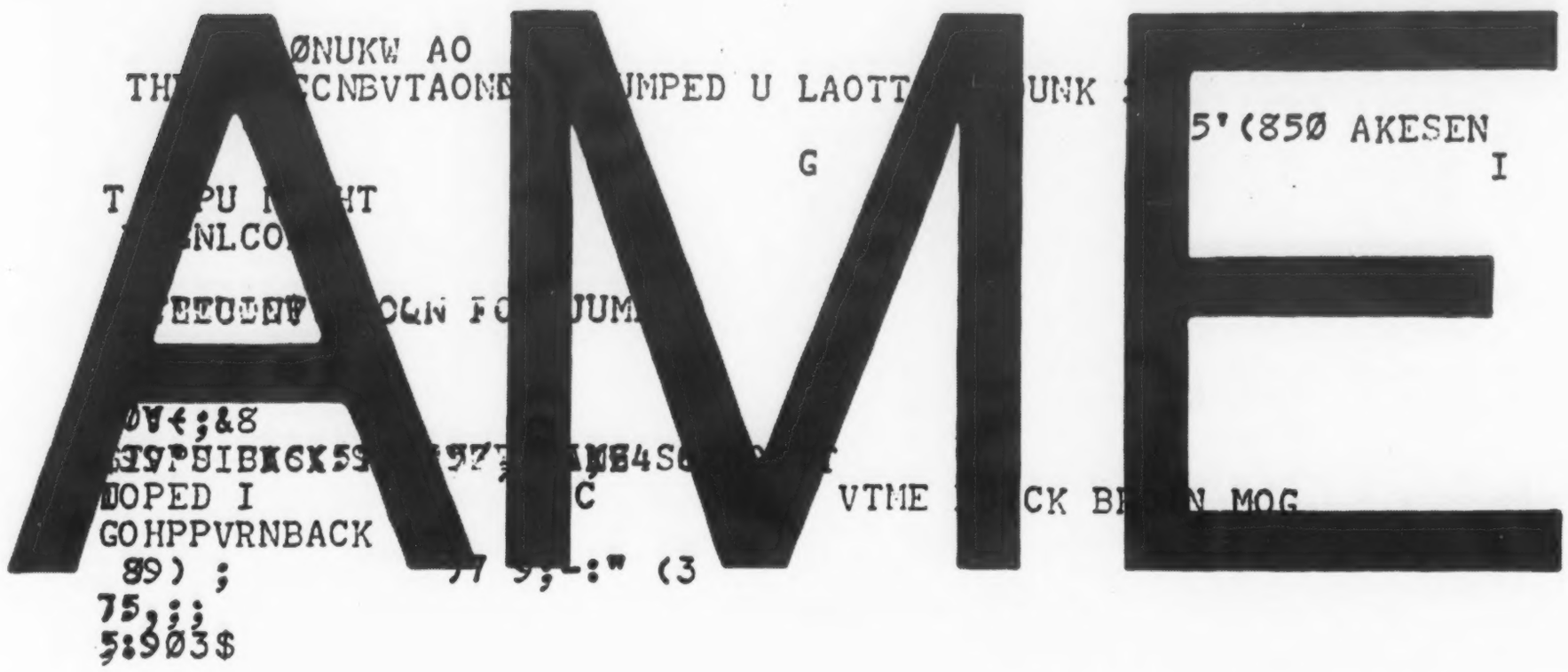
Wincharger Corp., a subsidiary of Zenith Radio Corp. ***Booths #3, 4***
E. 7th & Division St., Sioux City 2, Ia.

Dynamotors, Inverters, Engine Generator sets and Transistor Power Supplies.

Zenith Radio Corp., Parent Corp. of Wincharger Corp. ***Booths #3, 4***

Flash X-ray systems, radios, fuses and parametric amplifier tubes.

► Instruments for Industry, Inc., Booth #L ◄

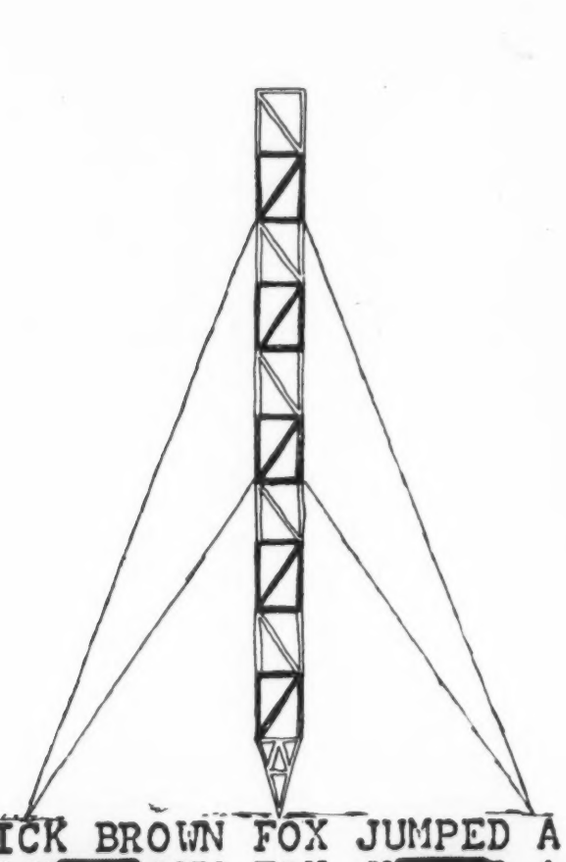


AME

Reliability in communications

The text above shows teletype breakup due to radio echoes. AME (Anti Multipath Equipment)—another significant accomplishment by PAGE—eliminates these echoes by synchronous stepping of the carrier frequency. Below is shown errorless copy made possible with AME.

Whatever your communications problem, PAGE has experience you can use. In research, in development, in systems engineering, PAGE engineers and scientists are advancing the state of the art. Our facilities include a complete laboratory and 100 acre field station.



PAGE

COMMUNICATIONS ENGINEERS, Inc.

A Subsidiary of Northrop Corporation

710 14th Street, N.W., Washington, D. C.

THE QUICK BROWN FOX JUMPED A LAZY DOG'S BACK 1234567890 AKZ SENDING
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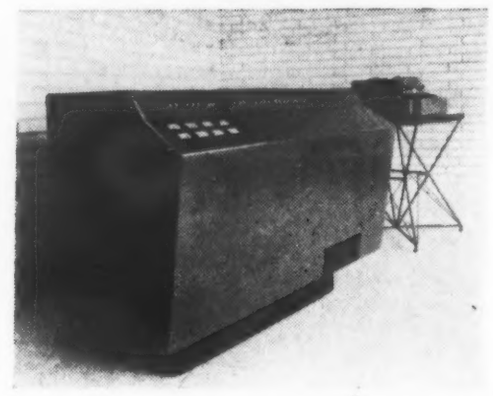
TRW

AND

SPACE AGE ELECTRONICS

Thompson Ramo Wooldridge Inc., through its combination of divisions and subsidiaries, provides an integrated organization capable of fulfilling the technological requirements of the Space Age. Communication and navigation components, equipment, and systems produced by TRW are well-known for their high degree of precision, strength, and reliability under severe environmental conditions.

Explorations in outer space are opening up interesting possibilities for new methods of communication and navigation. With products like those shown here, TRW offers its military and commercial customers a complete range of proven abilities—from basic research through precision production.



The RW-300 Digital Control Computer has broad applications in test facilities and data reduction centers.

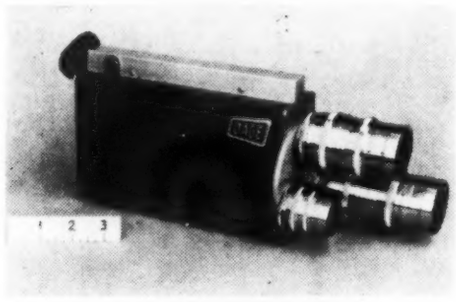
Divisions and Products

DAGE TELEVISION: Television cameras for military, industrial, and broadcast purposes; complete low-power television broadcasting stations.

RAMO-WOOLDRIDGE: Electronic reconnaissance and countermeasures systems, infrared systems, analog and digital computers, air navigation and traffic control, anti-submarine warfare, electronic language translation, information processing systems, nuclear energy applications, missile electronics systems, advanced radio and wireline communications.

TAPCO: Missile and aircraft auxiliary power systems, ground support systems, fuel systems, pumps, accessories, hydraulic systems, pneumatic systems; electronic control systems, microwave switches; frame structures, pressure vessels. Jet engine compressor blades, rotors, stators, and impellers; turbine buckets, rotors, and stators; structural and fabricated components. Rocket engine cases, nozzles and pumps. Nuclear reactor control rods, pumps, accessories, and core structures. Precision investment and continuous vacuum cast parts for aircraft, missiles, jet and rocket engines. Vacuum cast super-alloy ingot, billet and mill shapes.

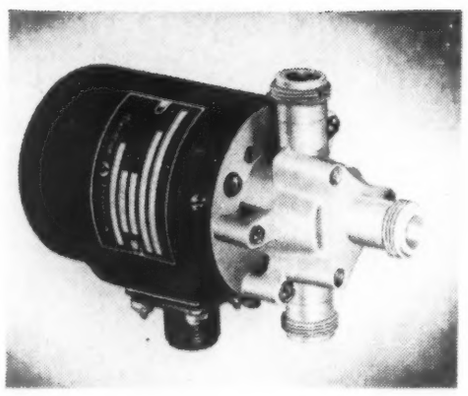
THE THOMPSON-RAMO-WOOLDRIDGE PRODUCTS CO.: Digital computers and associated equipment for on-line control, data handling and reduction, simulation, and computation. System and component testing, missile checkout, airborne data processing, and air traffic control applications.



This Dage Model 334 is the world's smallest TV camera. Dage TV systems have many applications for on-site, remote and vehicular use.

EXHIBITING AT AFCEA 13TH ANNUAL CONVENTION

Interested persons are invited to acquaint themselves with the broad range of TRW activities by visiting our exhibit, booths ABCD, Continental Room, Sheraton Park Hotel, Washington, D.C., June 3-4-5.



Coaxial Switch produced by the Tapco Group has wide applications in ground test communications equipment and in airborne guidance systems.

Systems are being developed by the R-W division for the processing and interpretation of photographic and other data.

Thompson Ramo Wooldridge Inc.

Main offices • CLEVELAND 17, OHIO • LOS ANGELES 45, CALIFORNIA

ELECTRONICS IN SPACE

SINCE WORLD WAR II, this era we live in has been called variously the atomic age, the age of automation, and now the space age. I know the people in the electronics industry are vitally interested in knowing what role they will be playing, what contributions they will be asked to make, what requirements they will be asked to fill in this latest, most exciting of our "ages."

According to the National Aeronautics and Space Act of 1958, "it is the policy of the United States that activities in space should be devoted to peaceful purposes for the benefit of all mankind."

This means that a large part of our research and development activities will be carried out under agreements with other Government agencies, with scientific institutions, universities, and, most importantly, with private industry. The part that the Armed Forces Communications and Electronics Association has played, is playing and will play in the future of things to come, is of recognizable importance to the future of our industry-military team concept.

Ultimately, entirely new generations of space vehicles must be developed and placed in use. Such vehicles must be provided with guidance and control mechanisms capable of much greater accuracy and reliability than those we now use. Tracking and data acquisition systems must be improved and many new stations installed in various parts of the world. Scientific experiments will increase in complexity with a resultant increase in the demand for more complex payload instrumentation. Capsules and cabins for manned space exploration in which astronauts can be sustained for days, weeks or months must be developed. As you look at this list—and it is not, by any means, an exhaustive one—you find one common denominator—electronics.

In this space business, we depend upon the electronic industry to make vital contributions to three major areas: design and fabrication of certain of our payloads; tracking, data acquisition and reduction and guidance and control of booster rockets.

A specific example will illustrate how great is our dependence upon high-quality, special purpose electronic gear. A few minutes after midnight, the morning of March 3, our United States team of NASA, the Army and JPL launched from Cape Canaveral a deep space probe, Pioneer IV. Its conical payload weighed 13.4 pounds and measured 20 inches in length and 9 inches in diameter.

Within those limits of weight and size, there was packaged the following: two Geiger-Mueller tubes to measure radiation—one of these was shielded with lead to cut out all but high-energy radiation; a photo-electric sensor, shaped like a pistol, to test its effectiveness near the Moon in activating picture-taking mechanisms in future space probes; a de-spin mechanism, to slow down the spinning of the payload package so the above-mentioned sensor could perform its mission, and telemetry equipment.

The telemetry equipment included a battery-powered radio transmitter, with three sub-carriers, designed to transmit continuously on a frequency of 960.05 megacycles for about 90 hours, using 180 milli-watts of power. The transmitter had to telemeter information about radiation, and about operation of the photo-electric sensor, which — incidentally, did not operate because it was set to work only after the probe got within about 20,000 miles of the Moon. Actually, the closest approach was 37,000 miles. There was also a monitor device, incorporating a germanium diode, to report on the radio beacon's transmitted power at the source, and an independent arrangement whereby operation of the de-spin device was telemetered to the ground station.

Today, unfortunately, our rate of progress in exploring space is handicapped by our lack of adequate payload capacity.

The ratio of weight between the launching vehicle of Pioneer IV (which was tracked to a distance of 406,000 miles from the Earth's surface, before it went on to orbit the Sun) and its payload was 10,000 to 1, and even when we begin using the launching systems of the Atlas class, the ratio will still be about a thousand to one. The new engine systems we will be using some years from now will have a ratio between launching weight and payload of about 200 to 1, for interplanetary missions, and perhaps as low as 50 to 1, for satellite uses.

As we press forward in our efforts to achieve more thrust and maximum reliability in these propulsion systems, we find ourselves smack up against another area in which we need very expert assistance. As I see it, we will be requiring very great contributions from the electronics industry to improve our means for guidance of space vehicle systems, not only for the "aiming" of them during the period of takeoff, but also, and perhaps more importantly, during the powered flight of the upper stages.

Although it was only a faltering first step on the road to development of a global weather forecasting system, Vanguard II was a very great accomplishment. The scientists and engineers involved now have a much clearer understanding of what must be done to develop a practicable system and we are planning the follow-on program with greater assurance than we had before that flight.

Communications satellites also offer great promise. The need for rapid and reliable global communications for the military is obvious, and studies have shown that there is bound to be a great increase in requirements for commercial global communications also. Independent analyses have predicted an increase in the total

(Continued on page 29)

Type No.
H-20
H-21
H-22
H-23
H-24
H-25

Type No.
H-80
H-81
H-82
H-84
H-89

Type No.
H-121
H-122
H-125
H-130

Typical RCA Ceramic-Metal Power Tubes utilize beam
power design, and feature high-efficiency forced-air cooling

RCA Ceramic-Metal Power Tubes

Known throughout industry and military services for high-efficiency operation and ability to withstand high voltages at ultra-high frequencies, RCA Ceramic-Metal Power Tubes are the answer for the designer who requires higher power in a smaller, compact tube design. No other power tubes in this class combine features such as: coaxial-electrode design; low-loss ceramic bushings between electrode contact surfaces; matrix-type cathode; extra-sturdy heater, low screen current, virtually no primary screen grid or control grid emission!

RCA Ceramic-Metal Power Tubes merit the attention of new equipment designers for a wide variety of applications. Your RCA Representative will be glad to discuss with you your requirements for RCA Ceramic-Metal Tubes and the availability of developmental types on a sampling basis.

Typical RCA Ceramic-Metal Power Tubes

Type No.	CW Service max. Plate Input (Watts)	Pulse Service max. Peak Plate Input (Watts)	max. Frequency for full Input (MC)	max. Plate Dissipati (Watts)
A-2582*	30	–	1215	25
A-2587*	–	3750	1215	25
6816	180	–	1215	115
A-2543-A*	–	9000	1215	115
A-2572*	1250	–	1215	600
A-2585*	–	64000	1215	600
7213	2500	–	1215	1500
A-2576-A*	–	180000	1215	1500
A-2545*	20000	–	400	10000
A-2581*	–	2000000	500	10000

*RCA Developmental Type—Available on Sampling Basis

GOVERNMENT SALES
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415 S. Fifth St., HUmboldt 5-3900
DAYTON 2, OHIO
224 N. Wilkinson St., BAldwin 6-2366
WASHINGTON 6, D.C.
1625 "K" St., N.W., District 7-1260

INDUSTRIAL PRODUCTS SALES
NEWARK 2, N. J.
744 Broad St., HUmboldt 5-3900
CHICAGO 54, ILLINOIS
Suite 1154, Merchandise Mart Plaza, WHitehall 4-2900
LOS ANGELES 22, CALIF.
6355 E. Washington Blvd., RAymond 3-8361
DETROIT 2, MICHIGAN
714 New Center Building, TRinity 5-5600

RCA® **RADIO CORPORATION OF AMERICA**
Electron Tube Division *Harrison, N. J.*

of overseas messages from the 1,500,000 level which existed in 1950 to 3,000,000 in 1960, and to 21,000,000 by 1970.

The use of satellites offers the possibility of solution to this growing problem of world communications. Using existing microwave techniques, a satellite system could be provided with almost unlimited bandwidth. Television, which requires the equivalent of 1,000 voice channels, would find great utility in this feature.

A technique we are going to explore will be a so-called passive system, with neither receiver nor transmitter carried by the satellite. The transmitted energy can be beamed at the satellite, but the reflected energy will spread out in all directions. Because of this, very weak signals must be detected by the receiving antenna.

On the other hand, the passive communications satellite, because it carries no electronics, lends itself to multiple simultaneous party-line use. Also, because there are no frequency determinants in the satellite, the bandwidth or amount of intelligence carried would not be limited as it would be for some other systems.

We plan to launch a 100-foot-diameter sphere into orbit this fall to study this passive-communications technique. The sphere will be made of plastic with a vapor-deposited aluminum coating to provide a radio-wave reflectivity of about 98%. In 1960, we expect to launch two more of these giant-size satellites which, incidentally, weigh 150 pounds.

Another system, perhaps farther off, would involve use of satellites carrying both a receiver and a transmitter. Signals beamed from the earth would be received and then immediately rebroadcast on another frequency.

Another area of interest to the electronics industry is data acquisition and computation. About $12 million of the $48 million supplemental appropriation requested by NASA in Fiscal 1959 will be used for increasing and improving our tracking facilities, including precision radar acquisition, tracking communications and associated systems for tracking mid-course re-entry and landing of the Project Mercury orbital capsules.

Pioneer IV established a record communications link of over 400,000 miles. But that was a fairly short transmission link when we consider probes traveling far beyond the Moon. That is why we are looking forward to the installations of MASERS and parametric amplifiers for use in connection with our big dishes. We must learn how to maintain communications up to 40 million miles in 1960 and to hundreds of millions of miles as soon thereafter as possible.

As for data handling, some experiments will require the transmission of raw data half way around the world from tracking stations to computation centers in the U. S. Other experiments may require the partial reduction of data at the receiving site before transmission.

Whatever the immediate task may be, contributions from the electronic industries will doubtless be just as applicable to the strengthening of military technology as they will be to the development of our greatest human resource—knowledge. In this spirit of high adventure, I look forward with the industry to the exciting days ahead. I do this with the fervent hope that our pursuit of the unknown in space may prove to be an important mechanism for bringing men and nations together for peaceful collaboration and competition, rather than as an added element in the cold war which is draining the world of energies that ought to be put to use for man's benefit everywhere.

Guided missiles of the future are *on our scopes today*—thanks to the agile brain of an amazing new ECM Simulator developed for the Air Force by Hallicrafters QRC.*

Designed for advanced study of jamming, deception and countermeasures techniques, the device furnishes to the PPI scope—*via the radar's own antenna*—exact simulations of moving targets, and jamming, in infinite variation.

Programming may be generated according to predetermined plan, or targets may be controlled manually. Speeds as fantastic as *270,000 m.p.h.*, as well as radical directional changes, now can be simulated for planning tomorrow's counter-measures.

ECM Simulator is another example of electronic design leadership that has made Hallicrafters a prime mover of key military projects for over 25 years.

Qualified engineers: *new contracts have created openings. Contact William Frankart.*

hallicrafters

4401 West Fifth Avenue, Chicago, Illinois

* Quick Reaction Capability
Refer to Air Force Reg. #80-32

Type No.
H-20
H-21
H-22
H-23
H-24
H-25

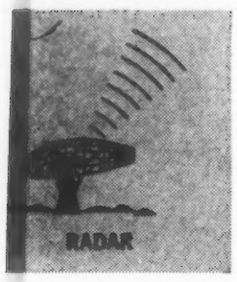
Type No.
H-80
H-81
H-82
H-84
H-89

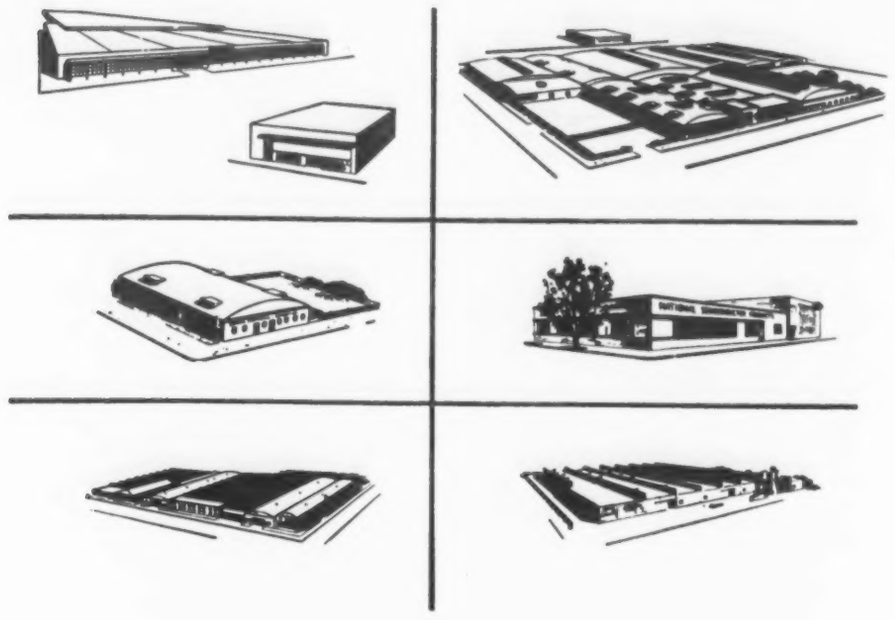
Type No.
H-121
H-122
H-125
H-130

Hoffman

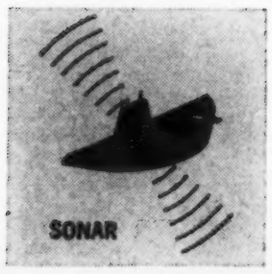
CAPABILITY

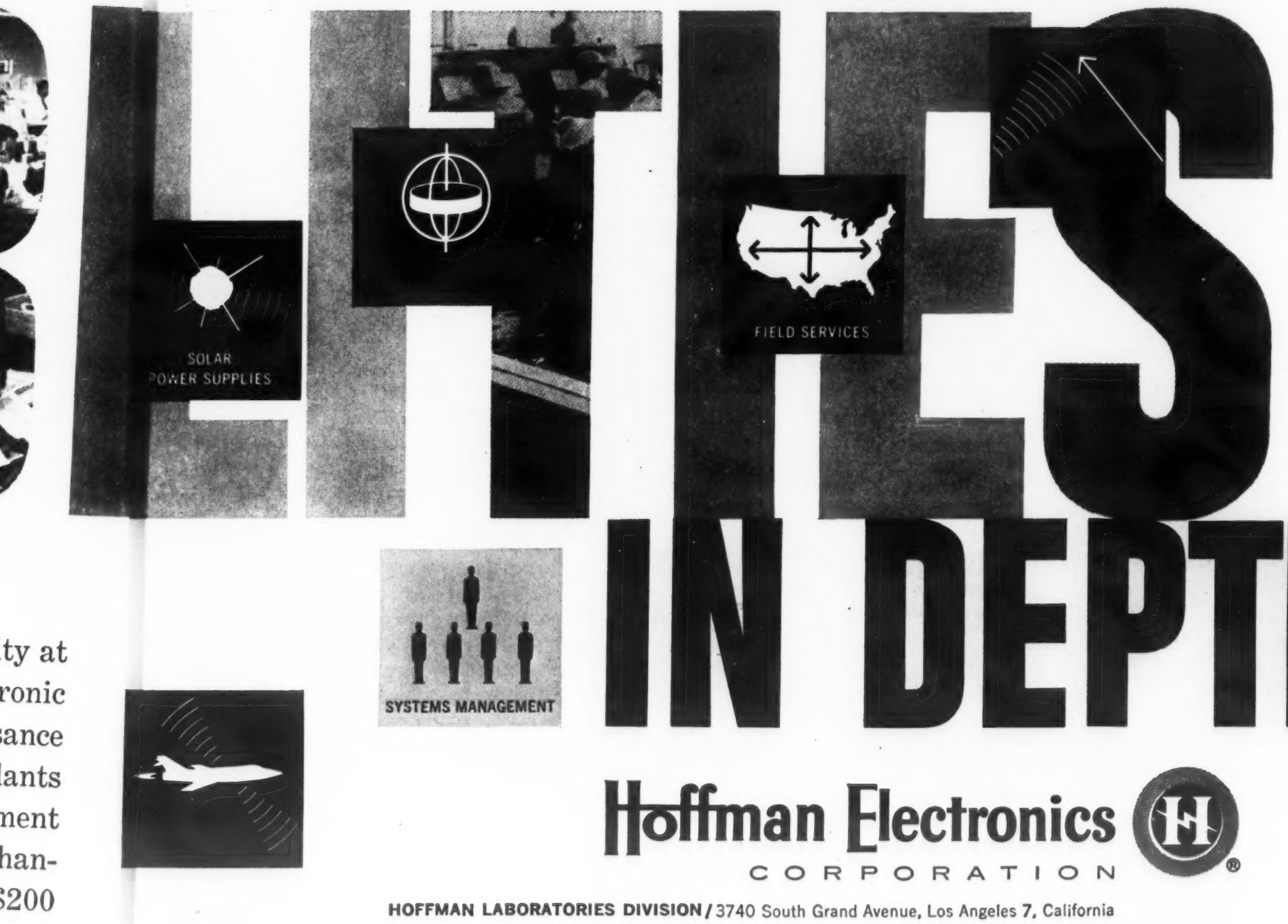
Here is capability you can see, measure...and use. Capability at Hoffman is 3000 skilled people. It is 18 years of experience producing military electronic equipment for applications ranging from undersea warfare—to infantry reconnaissance—to airborne navigation—to space exploration. It is seven major manufacturing plants totaling ¾ million square feet...plus a new 60,000 square foot Research and Development Center where skilled engineers and scientists are working on electronic and electromechanical projects for all branches of the Department of Defense. It is the ability to produce $200 million worth of military electronic equipment over the past years. It is a military backlog of $55 million and $40 million in 1958 corporate sales. This is Hoffman—where integrated research, engineering and production supply a *complete* capability in military electronics.





HOFFMAN FACILITIES
Seven major plants totaling 750,000 square feet located in Evanston, Illinois; Los Angeles, El Monte, and Santa Barbara, California.





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Hoffman Electronics CORPORATION

HOFFMAN LABORATORIES DIVISION / 3740 South Grand Avenue, Los Angeles 7, California

Missile Support Equipment • Radar • Communications • Electronic Countermeasures • Navigation
Semiconductor Applications • Electro-Mechanical Equipment • Weapons Systems • Field Services

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CHALLENGE IN SPACE

United Press Telephoto

by DR. WERNHER VON BRAUN
Director, Development Operations
Army Ballistic Missile Agency

Editor's Note: *Your editor had the pleasure of attending a select press conference for Dr. Wernher von Braun in Chicago during the National Military-Industrial Conference. Through the courtesy of Dr. von Braun, the following article was obtained for the readers of SIGNAL.*

WE DARE NOT underestimate Soviet capabilities and objectives in the limitless dimensions beyond the Earth's sensible atmosphere. We must understand the total implications to our future welfare if the Soviets succeed in their drive to achieve a dominant position in outer space.

Not many months ago these matters would have seemed incredible to most of our people. Subsequent events have lent substance and credibility to them. No longer do the loud cries of Soviet propagandists disturb our tranquillity although they cannot be dismissed lightly because of their impact upon the neutral and uncommitted peoples. Rather, it is the undisputed existence of a substantial capability in space technology and in missile-oriented industry behind the Iron Curtain which disturbs our tranquillity. In the space of only seventeen months, the Communists have surpassed our best efforts.

This is not an isolated phenomenon. It is integral to the Soviet plan to achieve supremacy by defeating free men in almost every phase of human activities. Not a single area of that plan for conquest can be evaluated competently without regard to contributing elements. Thus, the spectacular demonstrations of Soviet rocketry reflect astonishing progress in many fields: electronics, chemicals, metallurgy, missile guidance, propulsive systems and others.

The breadth, depth and momentum of the Soviet space program clearly indicate that it has received and will continue to enjoy the aggressive support of the Communist regime. The results achieved, and the profound influence they have exercised upon the international scene, have given the Kremlin dictators ample opportunity for self admiration. We can only guess at the echoes of these technological feats heard in the obstreperous boastings of the Soviet leaders. Not all the repercussions of satellite and space probe launchings are confined to the scientific community.

In the phases of the Russian space ventures about which information is available in the open literature, a close parallel can be found to much of the current and projected space research and investigations of this country. This is by no means surprising. It is as if two nations of widely different political and ideological philosophies decided, almost simultaneously, to explore the same unknown seas. Note that I said "almost"; the advantage of initiative is with the competition. The state of the art compels employment of much the same type of ship. The information available to the ship builders and to the crews about winds, currents, reefs and fueling stations is quite comparable. The differences have to do with propulsion, possibly the navigational equipment, and certainly with the ultimate goals of the explorers and those who expect to capitalize on the fruits of discovery.

Prudence dictates that we should carefully size up that rival fleet and try to determine its goals if we are to avoid Russian custom stations on the Moon and Mars and ensure that the results of exploration in space will not jeopardize the security of free men. The Communists have always employed human and other resources to subjugate helpless peoples and to extend their empire. I find no reason to expect any radical change in that strategy with respect to outer space and worlds beyond our own.

The U.S.S.R. Program

A brief summary of what is known about the Soviet program may be helpful. I would qualify it, however, with the observation that the data published in Russia suggests a tremendous, well-coordinated effort and that the disclosures themselves are by no means unpremeditated. They are assuredly intended to convince the unwary of Communist mastery and thus serve its strategic purpose.

- The first conclusion which I have already mentioned is that the Russian space program parallels much of the current and planned space programs of this country.
- The second is that a substantial part of the Soviet effort is directed towards manned space flight and the eventual exploration of the Moon and nearer planets by human crews.
- The third is that Soviet scientists and technicians are concerned exclusively with their own work and pay little heed to any possible competition from another quarter.
- Finally, it must be remembered that Soviet policy is to withhold specifics about any one project until it has achieved success, then to exploit it to the maximum. While they seem ready and willing to boast of the scientific aspects of their program, there is an ominous absence of any reference to possible military implications. Like the iceberg, we only know what the Russians want to tell us.

While we are concerned with the so-called "race into space" and its ominous portent, the Russians appear so sure of their technological leadership and their ability to retain the initiative that they do not even consider the possibility someone else might beat them to the Moon. Frankly, I do not know who could.

In December 1958, the President of the Soviet Academy of Sciences, Professor Nesmeyanov, discussed a new Seven Year Plan for the advancement of science. He pointed out that "considerable attention will be given to the development of new means of astronomical investigations by cosmic rockets and artificial earth satellites."

According to other Russian technical writers, each Soviet orbiter is the product of a continuously elaborated design program which draws upon the experience of previous launchings. More satellites are programmed for near and distant orbits, of prolonged and relatively short useful lifetimes, according to the publications.

Much attention is being paid to reentry methods preliminary to manned space flight. Dogs and other animals are employed in these experiments—without criticism, I suspect, from well-meaning pet lovers who decry the same kind of useful studies here. The Russians claim a successful recovery in August 1958, of a capsule containing two dogs which were carried to height of 450 kilometers in a payload of over one and one-half tons. Whether they acquired the ability to bark at their masters on this short excursion into freedom, the literature does not report.

A recent Soviet book on astronautics talks of permanent Earth satellites useful as inter-cosmic way stations, of manned flights to the Moon, of human visits to the nearest and then the most distant planets of the solar system, finally of visits to planets of another system. Russian technicians suggest galactic propulsion systems employing ionic and nuclear energy, even quantum rockets propelled by the flow of electro-magnetic waves.

At points as far separated as Franz Josef Land and the Antarctic, Soviet rockets and satellites have been fired that were equipped with instrumentation to study the upper layers of Earth's atmosphere and phenomena unique to outer space. We are told that satellite sensors confirmed the distribution of cosmic radiation according to longitude and latitude. This is strongly reminiscent of the Van Allen radiation belt discovered and measured by the *Explorer* Earth satellites and the *Pioneer* space probes lanuched by the U. S. Army's rocket team in connection with the International Geophysical Year.

The successful launchings of Earth satellites, in the words of one Soviet writer, "paved a clear road into cosmic space." He said these accomplishments "indicate the regular advance of the level of Soviet science and technology and the might of Soviet industry." I believe much the same thing could and should be said about the space achievements of this country, but for one reason or another too many commentators seem to be so preoccupied with our alleged inferiority as to deprecate some very solid demonstrations of our capabilities.

Other technical papers appearing in Russia of late disclose a keen interest in solar batteries and plans for larger energy sources of this type which would, again I quote, "make possible world-wide transmission of television programs beamed from satellites, the establishment of astronomical observatories beyond the atmosphere, and the continuous observation of meteorological processes." You will find the same applications discussed in the national advertising of the larger missile-related corporations of the United States.

The Soviets claim they accomplished direct measurement of certain atmospheric characteristics with *Sputnik III*. Also they measured the composition of ionized gases in upper layers of the atmosphere, the concentration of positive ions and the air pressure. These phenomena are important to the calculation of trajectories of space vehicles and to the maintenance of radio contact with them in flight.

Another indicator of the direction of Soviet interest was the claim that *Sputnik III* carried magneto-sensitive transducers to assist in orienting the vehicle in space. This orientation would be essential to accomplish photography of Earth's surface from a satellite, to return satellites to Earth, and to assist the navigation of ships, aircraft or interplanetary vehicles. A Russian writer claimed *Sputnik III* could carry one or two human passengers and equipment on a 10-day space journey. This vehicle, I might add, utilized thousands of semiconductors and its programming unit was completely transistorized.

I believe this sampling indicates the Soviet program is at least as comprehensive as is ours at this point in time. It makes use of tracking, recording and experimental stations spotted throughout the Communist world so that the peoples of satellite nations are supposed to be persuaded that they are contributing to it.

The *Lunik* space probe, in the opinion of U. S. rocketeers, proved once more that the Russians have rocket engines of substantially higher thrust than any we have fired. Chances are that for this flight they employed the same booster utilized to launch *Sputnik III*. An additional stage was probably placed on the two-stage booster to push injection velocity up to the level necessary to break out of Earth's gravitational field. The velocity actually achieved may have exceeded expectations. Russian sources reported the final stage weighed approximately 3,000 pounds. The payload itself and its electrical power supplies weighed approximately 700 pounds compared to the *Pioneer IV* probe of 14 pounds which became the first made-in-the-USA satellite of the Sun.

It is obvious that substantial accuracy was required for the *Lunik* rocket trajectory. We must therefore conclude that the Russians have an impressive long-range rocket guidance system. It may also be surmised on the basis of the evidence that Soviet guidance systems can constrain rockets carrying warheads over intercontinental ranges and hit cities or relatively small target areas. This is the grim fact and there should be no misunderstanding about it. How many of these rockets may be in the arsenal, I do not know. It should also be kept in mind that due to the geographical situation, the Soviets can exploit medium range missiles of lesser ranges, perhaps only a few hundred miles, to blackmail our NATO allies.

I am convinced the Soviet intention is to reinforce penetrations on economic, political and psychological fronts wherever and whenever opportunity affords by the naked threat of thermonuclear destruction instantly available in the guise of missile carriers. Of vastly greater significance in the days and years ahead, they expect to attain dominance in space the better to compel the recognition of Soviet supremacy upon the peoples of Earth. Both objectives could, in my opinion, be achieved without ever firing a missile against a target in the Free World, or without ever releasing a glide bomb from a military vehicle in space that could be directed to any spot on Earth's surface. Remember—whether a satellite carries scientific equipment or lethal warheads is simply a matter of choice exercised by the authority controlling the vehicle.

I say these things are possible and indeed they are. What then is the alternative open to us? It seems quite clear the only recourse, and I do not for an instant believe we intend to sit idly by and await the day of Communist judgment, is to forge ahead

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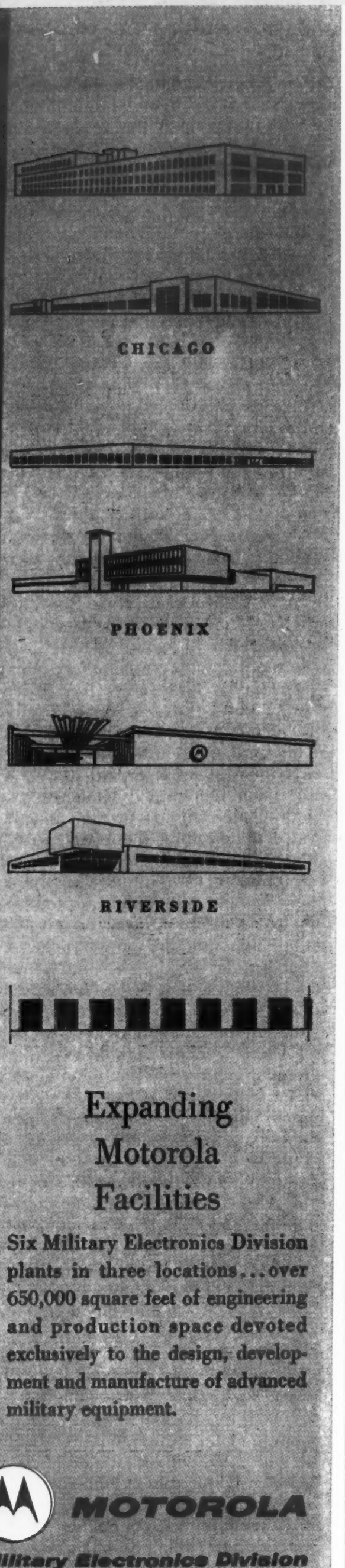

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(Continued from page 33)

with all possible speed and achieve an overwhelming competence in space by the exploitation of our impressive technological and industrial resources. Then, even the most ambitious among the Red dictators may be persuaded of our determination to keep space free of political implications and to search out its mysteries and wonders in the best interest of all men. The prospect of communization of other worlds is one from which we can only recoil in disgust unless we assert the necessary leadership.

It is one thing to state this determination and quite another to accomplish it. Admittedly a gap exists between our rocket capabilities and those of Russia in the space area. It is very difficult to say when that gap can be closed because this would require complete knowledge of the competition's resources and the speed of his advance—information we do not have or which is not available for the purpose of this discussion.

The assumption that nothing was done in this country during the years when the Soviet Union was busily engaged in rocket development, which was climaxed by the development of *Sputnik I*, simply does not jibe with the fact. The groundwork for U.S. space vehicle instrumentation was laid at White Sands Missile Range during the years following World War II. Rockets carried aloft sensing devices, photo cells, density and pressure meters, even live monkeys. When we turned to satellite launchings, beginning with the first *Explorer* in January 1958, the instrument packages borrowed heavily upon the early knowledge obtained in the period from 1945 through 1949.

We did not work on large rocket engines of the *Lunik* order for the reason that such power plants were not required for the military missile systems in development from 1955 on. We are at work now and have increased the speed of our effort. It may still require as long as five years to overtake the Soviets and move out in front and stay there. Unless we continue to accelerate our momentum, I advised the United States Senate that within 10 years it will be too late—we could not then hope to catch up and by then the Russian foothold on the nearer planets might have attained a stature which could not be challenged.

One of the most vital of the current programs is Project Saturn, a clustered booster we are assembling for the Advanced Research Projects Agency. This will make available a thrust of more than 1,000,000 pounds, twice as powerful as the largest so far fired by our competitors. *Saturn* is really the first of the second generation of U. S. space vehicles. Those of the first generation, and we are still within that frame, depend entirely upon existing missile systems developed by the armed forces to meet the requirements of national defense. Our space payloads have consequently been limited to the thrust potential of these systems and this situation will obtain until true space vehicles are ready for use.

With the *Saturn* vehicle it will be possible to launch a communications satellite capable of serving the worldwide needs of the Strategic Air Command of the Air Force, the submarine fleets of the Navy, and the tactical commands of the Army.

The National Aeronautics and Space Administration supports a project aimed at obtaining boosters larger than *Saturn*. Since this program is essentially new it must recognize the time required for enginering and its availability is a matter of several years away.

Meanwhile, we should be prepared for other dramatic Soviet experiments: man in space, possibly the landing of an instrumented vehicle on the Moon, terrestrial and weather observation satellites, photography and mapping of the entire Earth's surface. We must expect such happenings because they are part of the logical development of that broad program I have described.

Dr. Keith Glennan, the Administrator of the National Aeronautics and Space Administration, recently told the Congress his agency is proceeding at all possible speed with the expanding space program. I can assure you no grass is growing under the feet of the Army team in Alabama, even though, in my opinion, they might move faster if added funds are provided. We would much rather wear out shoe leather now than to be trading in a Soviet state store a generation hence.

Those of us who are closest to the situation sometimes feel our concern is pretty much a private matter not generally shared by the country as a whole. In some quarters this is taken to be a rivalry between competing fireworks manufacturers with little consequence except possible damage to national pride.

We have not succeeded, I believe, in awakening America to the peril so grave it cannot be overstated.

We should, in my opinion, substantially increase basic and supporting research programs which extend

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beyond the immediate defense need. A great deal of engineering effort has gone into the exploitation in recent years of the discoveries of science. Rocketry is but one of many areas in which this logical process has occurred. But we have reached that point where the well of fundamental knowledge in the natural sciences is about exhausted and pitifully few people are trying to refill it.

I have suggested that project funds ought to be increased in all areas to provide money for promising investigations which may crop up in the course of development. No one can anticipate their occurrence or their possible yields, but I believe sizeable returns could come out of relatively small investments. Even if many proved unfruitful, we should at least have learned what not to try next time and that negative information would save money and time later.

It is also essential to approach space projects in much the same manner in which we carry on the development of complex weapons systems; that is, by system, rather than piecemeal. Instead of developing a booster, then deciding what upper stages will be adapted to it, what guidance system should be used, and what kind of experiment should be launched, the whole project should become an integrated undertaking in the interest of compatible design and telescoped scheduling. The nature of the competition and its momentum do not permit the leisurely approach—we must work with a genuine sense of urgency.

As a final warning I would restate my conviction that this is not a technical struggle between competing teams of rocket builders. We are under heavy attack on all fronts by an energetic and resourceful adversary who has built up a massive technological effort. This is being strengthened by an enormous reservoir of scientific and engineering talent constantly replenished by a state-directed educational program. While the attack has been at least temporarily deterred from military adventure, it is being pushed in all other directions. This is becoming a test of the stamina, the resourcefulness, the courage, faith, skill and ingenuity of every American. At stake is the future of freedom, human progress and now the Universe itself.

The Age of Space can become the greatest of all the periods of history for our children, or it can end in catastrophe so terrible that the mind cannot grasp the consequences. The choice is ours to make but only if we exercise our selection in time.

a factual appraisal

SIGNAL COMMUNICATIONS FOR THE FUTURE

by col. g. p. sampson

Chief, Army Communications Service Div.
Office of the Chief Signal Officer

MAJOR EXTENSIONS and improvements in Global communications systems will be necessary to respond to future needs of the military. These certainties are based on known requirements of the future, many of which have already been permanently established. Some improvements are being undertaken immediately, others must be phased during the future, all are ultimate and certain goals.

Of immediate concern are transportable high-power communications terminals, trained personnel to permit flexibility of units designed for multi-purpose operation, and steps to overcome the several deficiencies of long-range transmission.

Of immediate future concern is the need to implement plans for a Universal Integrated Communication System (UNICOM) which will provide personalized service, high-speed automatic switching, and any mode of transmission such as video, data, facsimile, voice and records communications on a completely secure basis. With this system should come the use of satellites as repeaters—corollaries of the ground stations now employed.

While the implementation of this concept will represent a vast improvement, I can't help but think that when we have it, it will be as unsatisfactory for future requirements as what we have today is unsatisfactory for present requirements. What we really need is this concept implemented yesterday, and something else 15 to 20 years from now. In communications, we are not keeping *ahead* of the times which is necessary insofar as military needs are concerned—abreast is not sufficient.

There are several technological fields closely associated with communications that have enjoyed a rate of progress in the past 15 years far exceeding the rate experienced by supporting communication technology. Of particular interest is the fact that weapons systems are rapidly outgrowing the existing communication capability. Recently stated military requirements were made for instantaneous communications to all elements of certain weapons systems. The commands responsible require instantaneous and continuing information concerning the engagement of their weapons systems, and the status of individual elements thereof. This they require *now*. Of more concern at this moment, however, is the fact that this is only the beginning. The science of weapons and other sciences are beginning to find themeslves in a position where they must lift the communication complex to their level in a "boot strap" operation. The time is approaching—in fact, it is here—when the lack of suitable communication facilities begins to impair the application of advances in other technological fields.

Perhaps one of the reasons this happens is that we haven't given enough thought to systems concepts. We take great satisfaction in new communication techniques —such as forward scatter. Although this means of communications is valuable, we lose sight of the fact that it is still used for transmitting signals which have changed little since the telephone, teletypewriter, and facsimile devices were invented.

Another reason for being behind, perhaps, is that it is easy to manage the type of communications we are interested in if we are satisfied with the way things are being done now and with adapting commercial techniques to the military system. Unfortunately, this is not adequate. The commercial system is not vitally concerned with security, data display, reliability, and speed needed by the military world-wide. Even in the United States where the commercial systems are concerned with meeting the customers' requirements, accomplishment is not always possible. We talk today of magnetic tape to mag-

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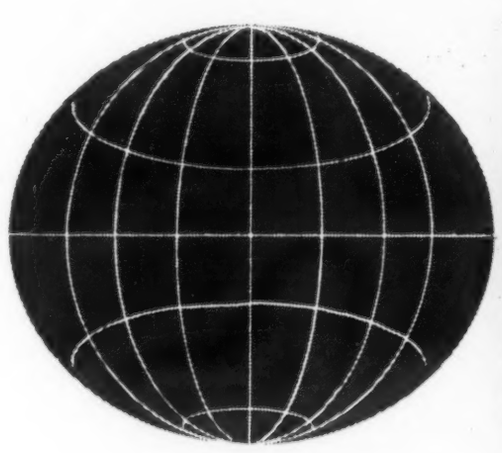

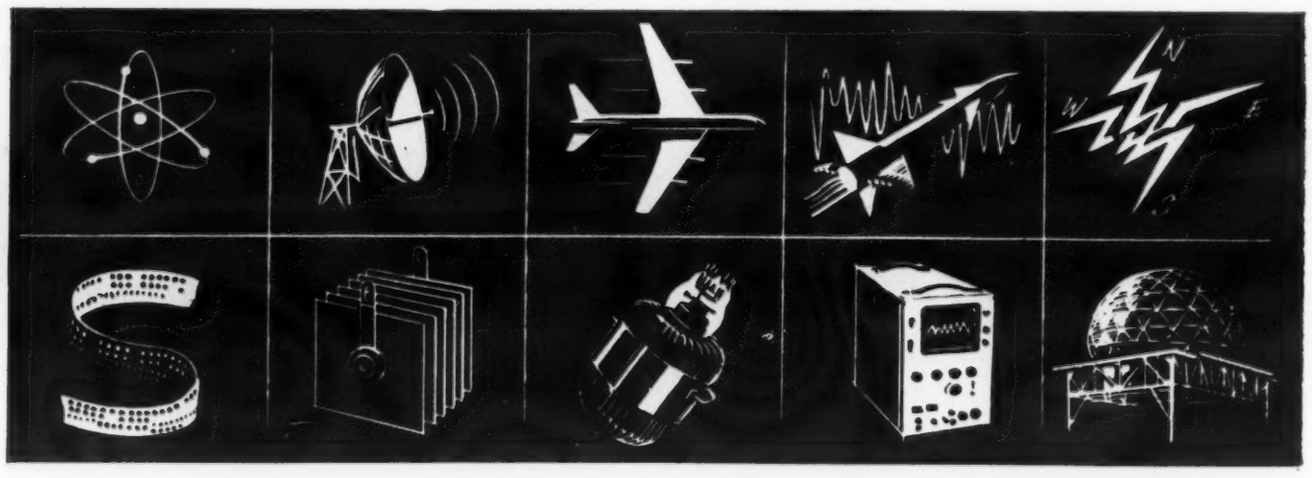

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ITT System factories in 20 countries produce an enormous diversity of electronic equipments, such as aircraft power supplies, infrared viewers, battery chargers, high-power inverters, radio marine aids, radio apparatus, large-screen oscilloscopes, simulators, radio frequency welding equipment and studio controls. The combined equipment output of ITT's domestic and foreign engineering and production facilities is geared to meet a wide range of applications "off-the-shelf!"

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The research and manufacturing facilities of ITT companies are extensively employed in scores of phases of military electronics. In missilecraft, ITT capabilities range from drawing board to launching pad—from take-off to target. ITT develops countermeasures and counter-countermeasures, IFF systems, infrared systems, radio navigation for supersonic fighters, inertial and celestial navigation, ground and airborne radar equipment, reconnaissance and surveillance equipment, as well as many secret projects. A special Astrionics laboratory is now engaged in developing satellite radio relay techniques for global TV and telephony and navigation and communications systems for manned space ships.

AIR NAVIGATION SYSTEMS

ITT has long been identified with the development of important electronic navigation aids for world-wide commercial and military aviation, including jet aircraft. The scope of ITT capabilities in this area embraces such systems and equipments as: Low-Approach Instrument Landing System (ILS), Tacan, Tacan Automatic Reporting and Data Link, Vortac, Traffic Control Center Systems, Ground and Airborne Radar, VHF Airport Radio Direction Finders, Four-Course Radio Ranges, Narcast (weather reporting), VOR, DMET, GCA, Navaglobe, Navarho, Loran, Consolan and other radio and radar aids.

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The depth of its experience and the breadth of its activities have made ITT a recognized leader in wire and radio communications. ITT is a source of complete dial telephone systems, intercommunication systems, carrier, over-the-horizon microwave, line-of-sight microwave, broadband microwave, aircraft communications, AM and FM radio broadcasting, television broadcasting, point-to-point radio, ship-to-ship and ship-to-shore radio, closed-circuit television, vehicular radio, and telegraph equipment. From ITT factories come equipment for telemetry, facsimile, data transmission, record communication, automatic telegraph retransmission and cryptographic communications, also teleprinters, and coaxial and submarine cable systems.

AUTOMATION SYSTEMS

ITT System companies have decades of experience in the fundamental principles of electronic switching and transmission, as applied to all types of computing and automatic control. ITT automation systems are already in operation or being built for customers as varied as post offices, banks, mail order houses, railroads, libraries, oil companies and air forces of several NATO governments.

ITT supplies repetitive clerical processes control systems, digital and analog computers, data and information processing systems, check handling and mail handling systems, inventory and reservation control systems, order processing, record communications, remote control indication and spectroanalysis, also automatic routing and sorting systems, pneumatic tube systems, document conveyors and punched tape equipment for perforation, reading, transmission and distribution. ITT produces many associated items for automation applications, such as relays, switching systems, counters and analog-to-digital converters.

SYSTEM MANAGEMENT

ITT globally-distributed engineering personnel and facilities provide capacity for complete system management anywhere in the free world. Recent examples are the Eglin Gulf Test Range, the test range at Edwards Air Force Base and LOBAR (advanced heavy radar system). The newest ITT system management project is a world-wide electronic control system to transmit, process and display data for the Strategic Air Command.

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(Continued from page 37)

netic tape transmission or of data transceivers sending 100 cards a minute, yet we know that to do this the existing system must be "gold-plated." Any possibility of alternate routing is out of the question unless additional time-consuming, expensive "gold-plating" is accomplished.

We cannot afford to move only as fast as evolutionary techniques permit in the development of a new system, because our needs and requirements are urgent. To be content with such progress for military needs can be defined as "off-the-shelf" thinking. If this philosophy had been followed during World War II, we probably wouldn't have had radar for many years nor in all probability would we have had nuclear fission until much later. We cannot accept this as our philosophy with regard to communications. Evolutionary techniques or "off-the-shelf" thinking just do not apply in communications when the weapons systems which communications must support are generated by another set of rules. The same rules must be applicable to both.

We must achieve the capability where the extension of man's powers through the harnessing of the electron compares with the extension of man's physical power through the harnessing of the atom. The electronic computer and the techniques therein are the key to the military's future communications needs—they set the technological pattern. Wars will be won or lost depending upon the progress of individual combatants in applying electronic data processing techniques to military coordination and control problems as well as scientific problems. Today, we cannot realize the full capabilities of electronic computers, either in military or civilian applications, due to limitations imposed by an inadequate communications system.

Complete integration of data processing techniques and communication systems must be accomplished. Such a communications system must accommodate data at computer speeds with complete security over great distances. Secure video bandwi'th in the order of 40 or 50 MC must be handled world-wide. Auto-input devices must be developed to eliminate to a large degree the requirement for manual preparation of computer system input data. Auto-abstracting must be developed to permit a computer to filter its stored information down to those essential elements required for decision making.

We must give greater consideration to the decision maker—the commander in relation to our communications computer system. This represents somewhat of a departure from previous philosophies, when, it was deemed necessary to protect the commander from being influenced by the systems engineering and related electronic technologies. Unfortunately, this concern over the integrity of the commander and the way he does his job has created a gap between electronic systems and the men they serve. We cannot divorce the system of the future from the job men do, nor should we be hesitant about influencing the men or the way they do their jobs when we design our computer-communications system.

Trunking capacity (not the number of trunks) must be increased to ten thousand times that available today. This must be accomplished without a proportionate increase in cost. From an economic standpoint, the cost of electrical communications world-wide must and can be reduced to the extent that it is competitive with postal systems. In fact, our goals should be to eliminate the mails; that is, the physical transportation of information, as a means of communications. Unlimited trunk capacity and electronic scanners and printers can virtually eliminate terminal processing delays normally expected in electrical communications.

Input from the human mind to the computer/communication system must be given careful analysis to eliminate time-consuming manual operations. The objective must be to eliminate all intermediate operations if possible.

To do this, it isn't sufficient to sit back and say, "What we need is research." Certainly we need research, but what type? We usually think of this field as an effort to discover fundamental knowledge—pure research. Also, there is applied research. Neither is applicable here although the latter requires comment. In a recent issue of the *Armed Forces Management Magazine*, it was stated that half of the scientists' and engineers' time was spent learning things that had already been learned. In many instances fundamental knowledge has gone unused for decades because of a lack of application for this knowledge. Perhaps there is room for improvement here.

One cannot blame the research and development people —the applied researchers—for our failure to advance more rapidly when the communicators have not provided objectives to guide them in digging out fundamentals for appropriate application. The lack of appropriate objectives, which should have been expressed by the communicator or the user, is the reason we are behind. The research that is missing is operations research applicable to military communications.

In the projection beyond the long-range time frame — we obviously must establish objectives, our target for concept planning and applied research. The commodity for these objectives is imagination. Could the present state of the radio science have existed at all if someone in the far distant past had not imagined the transmission of the voice and thought through space? Television certainly began in the imagination. Undoubtedly at the time there was little concept of how visual information could be transmitted. Nevertheless, from this imaginative creation came the stimulus for television as we know it today. The point here is that in order to provide the required objective for applied research and concept development there need not be any concept of "how." To fill the gap that exists we should state long-range operational objectives—take the position of the Evangelist of Utopia and state Utopian objectives on the principle that subsequent treatment will make the net result something less than Utopian.

This remark should not be construed to mean that we should concentrate all of our efforts on the long-range areas first. We feel, however, that existing programming systems give us the basis for handling the short-range problems. The development of the concept established in UNICOM provides for the mid-range and so-called long-range periods. As time progresses, phases of UNICOM will be integrated in our 5-year program and UNICOM itself will change during the period it is being developed as the state of the art changes. It will only change, however, if there are objectives beyond UNICOM as presently conceived to guide the changes.

For the projection of UNICOM beyond this time frame. we must start now to provide objectives to the research and development elements to guide the transition from UNICOM to whatever may be its replacement.

This communication-electronics business has hardly developed beyond the embryonic stages. Possibilities are unlimited and we need only establish appropriate goals for which we strive. This, I am sure, we can do through coordinated efforts of all communicators. If we don't, the Achilles heel of the future military world-wide weapons systems will most certainly be communications.

We must put the same effort on Global communications as we do on tactical communications and weapons systems. Unless we do, it may not make much difference how much effort goes into anything else.

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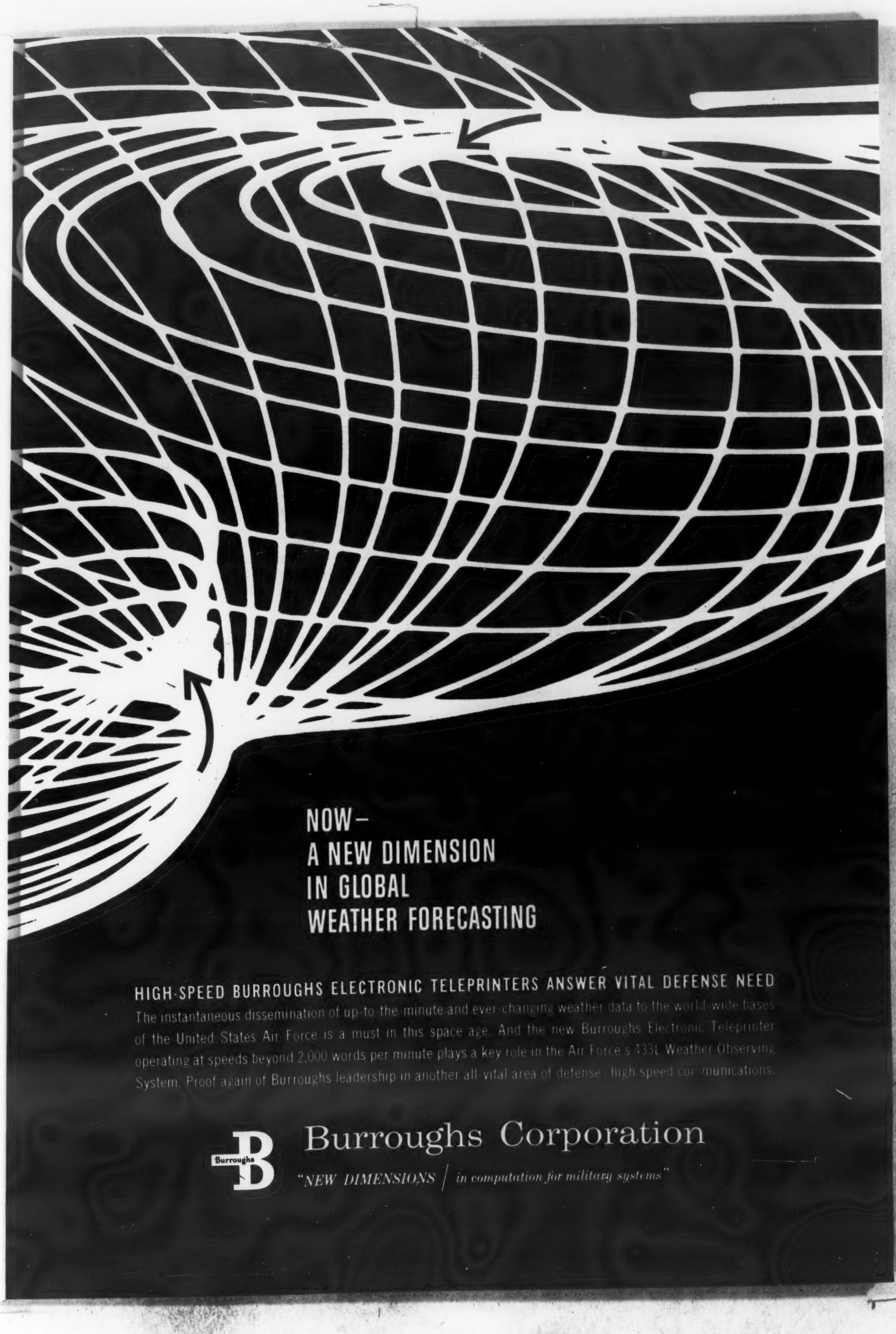
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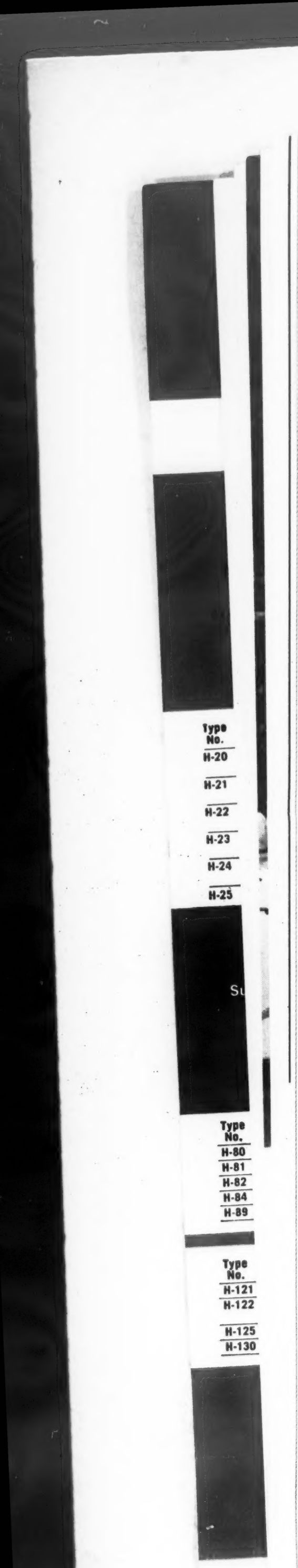

TRANSOCEANIC COMMUNICATIONS

by C. C. CUTLER
Bell Telephone Laboratories, Inc.
Murray Hill, N. J.

WILL WE soon be communicating around the world by means of radio signals relayed by earth satellites? Will the space age make it possible to span the oceans with live television programs; for generals to watch a battlefield half way around the globe; for the President to address the world on TV; for the Hindustani to watch Howdy Doody? There are those who think that it will, and soon.

Signals may be relayed across the ocean by reflection from passive satellites—giant spheres, high above the surface of the earth or great flat mirrors oriented to reflect ultra short waves back to earth. Alternatively, messages may be relayed from active radio repeater stations similar in principle to those used to transmit signals across continents but elevated into satellite orbit so that one repeater can serve where it now takes dozens to cover a few thousand miles.

The possibilities are legion. The problems are also legion, so it is fair to ask just where we stand today, which of the many possible systems looks most practical for present day technology, and what are the important problems and limitations of this method of long distance communication.

Present transoceanic communication is limited to very long wave and short wave radio and a few submarine cable channels of telephone bandwidths. The initial cost of an overseas voice channel is near one million dollars, and in spite of the cost they are saturated most of the time. There is little likelihood that present methods can provide television service for years to come. There is need then for a wider bandwidth, more economical service.

That earth satellites would be useful as relays for long distance communication was prophesied by Arthur C. Clarke* fourteen years ago, and serious calculations of the possibilities were published by J. R. Pierce** in 1955. Even as late as 1957, communications by means of satellites appeared to be a question for science fiction writers, and very uneconomical, even if satellites could be erected. In very recent years, however, a number of exciting technological developments have taken the subject out of the realm of fantasy, and made the practical achievement of satellite communication imminent.

Technological Advances

The most important development toward making such systems possible is, of course, the demonstrated ability to put large packages into orbit around the earth. Without this the subject would still be pure speculation. Today, artificial satellites weighing several tons and carrying complex electronic gear circle the earth, and a thousand-pound satellite flies in space, having been accelerated by man to greater than escape velocity. Satellites of the size and complexity required for useful communication purposes certainly can be erected.

Also of very great importance to the design of communication satellites is the silicon solar battery. There are other possible sources of satellite power, to be sure, but none today rivals the simplicity and efficiency of this device. By properly treating thin wafers of specially prepared silicon, and providing them with electrodes, a device has been developed which converts as much as 10% of the incident solar radiation into electricity. It requires only about a pound of battery to produce a watt of power continuously, and probably for many years.

Of scarcely less importance is the development of broad-band high-frequency transistors. It now appears that all of the electronic functions in a communications satellite, except possibly for the final high power output stage, can be provided by solid-state devices—much more efficient and longer lived than circuits using vacuum tubes.

Another important factor is the development of low noise microwave receivers. The advent of the MASER* (*M*icrowave *A*mplification by *S*timulated *E*mission of *R*adiation) and the parametric amplifier put an entirely new light on the receiver problem, and oddly enough on the antenna problem too. The MASER makes use of electrically stimulated changes of energy levels in certain crystals, or in ammonia gas, to produce amplification of microwave energy. It does this at temperatures approaching absolute zero, and in a manner that generates practically no noise. Noise is generated in associated circuitry, to be sure, but this can be kept small enough so that effective noise temperatures of only a few degrees absolute have been measured.

The parametric, or variable reactance amplifier, sometimes called MAVAR promises to rival the MASER in low noise receivers, especially at lower frequencies where it is more difficult to make a MASER.

When an element of a resonant circuit is varied at a cyclic rate nearly twice that of the frequency of resonance, energy in the circuit is amplified in a way that is free of noise. The variable parameter may be the capacitance of a crystal, the inductance of a ferrite, the

*A. C. Clarke, "Extraterrestrial Relays," *Wireless World*, Oct. 1945.

**J. R. Pierce, "Orbital Radio Relays," *Jet Propulsion*, Vol. 25, No. 4, pp. 153-157, 1955.

*J. P. Gordon, "The MASER," *Scientific American*, Vol. 199, No. 6, Dec. 1958.

BY MEANS OF SATELLITES

space charge in an electron beam, or the length of a pendulum. The parametric amplifier does not equal the performance of the MASER but it has other advantages such as the fact that it operates at room temperature and uses more conventional materials.

One might ask how low a noise level it is practical to use in a receiver before extraneous radiation is limiting. Fortunately radio astronomers during the last decade have carefully mapped out sky noise intensity so that now we know the limitations set by nature. There is a broad minimum in sky noise, extending from about 1,000 megacycles, below which cosmic radiation gets very large, to around 10,000 megacycles, above which oxygen in the atmosphere becomes an important source of thermal noise. Anywhere in this range it should be possible to operate with effective receiver temperatures of less than 20° absolute; i.e., less than one fifteenth of room temperature.

It is not yet known just how low in noise it is practical to go, but it is clear that in the microwave range it is now possible to build and use receivers with a hundredfold smaller noise level than could have been predicted a few years ago. This means a hundredfold reduction in required transmitter power.

Of course to take advantage of these low noise temperatures it is necessary to guard against man-made interference and thermal radiation from the ground. The development of giant antennas, ranging from 60 ft. diameter paraboloids useful in the lower part of the microwave range to the 250 ft. diameter "Manchester dish" useful up to a few hundreds of megacycles, is in the direction of producing more directive beams and thus better discrimination against terrestrial sources of noise as well as extremely high antenna gains. Ordinary paraboloids are expected to achieve a noise temperature limited by thermal radiation from the earth of around 50° absolute. A special horn-reflector antenna being built at the Bell Telephone Laboratories Holmdel location promises to have a far reduced sensitivity to radiation from the ground, and to be truly limited only by the temperature of the sky and the amplifier to which it is connected.

Another development of great importance is that of high power tubes. Klystrons and traveling wave tubes of many kilowatts continuous power capacity, recently developed for particle accelerators, radars, and television broadcasting, are available for use in satellite relay terminal stations.

Other factors are also important such as miniaturization of electronic parts, printed circuitry, and more efficient modulation systems, all of which have been advanced greatly in the last few years. Continued advances should make the proposed systems even more promising as time goes on.

A Simple Long Distance Delayed Message Service

Expediency is a most important consideration in the design of satellite communication systems. A system designed for immediate usefulness will be quite different from one designed for some distant future application. Let us first see what might be done within today's demonstrated capability, and subsequently describe more futuristic possibilities.

At present we know that satellites of several hundred pounds can be erected in orbits of a few hundred miles altitude. Suppose then that we put a satellite in a 300 mile high orbit, which is high enough to give it an expected life of several months, and equip it with a radio transponder—a repeater which retransmits whatever it receives, but at a different frequency. Such a repeater would be within line of sight of stations 1500 miles away and could act as a repeater between stations which are within 3,000 miles of each other. Of course this would be of little use, since only occasionally would it be simultaneously visible from two widely separated stations, and then only for a few moments at a time. A low altitude satellite such as this has its greatest usefulness as a message carrier, by recording whatever it receives and transmitting at a later time as it passes over the message destination. For this it needs power to transmit the signal only a few hundred miles and can deliver a message anywhere in the world within a few hours.

Indeed, this is no prophecy. This message carrier has been demonstrated in the talking satellite which carried President Eisenhower's Christmas message to all the world. Only a few watts from a non-directive antenna suffices to transmit the message to conventional receivers on the ground, and a few hundred watts on the ground suffices to interrogate the satellite. The step from this simple demonstration to a continuous useful message service is a straightforward one, and one can look forward to such message-carrying service very soon.

To communicate directly with any reasonable efficiency requires satellites at much higher altitude. The optimum altitude, for minimum propulsion and maximum radio transmission over a 2,000 mile path, appears to be near 1,000 miles. It is already within present propulsion ability to place satellites of the required weight at such an altitude. A repeater, amplifying and re-transmitting radio waves from a satellite at 1,000 miles or so altitude, could be seen 7% of the time from opposite sides of the Atlantic. This would give an intermittent broad-band communication service of great value. A hundred such

satellites in a more or less random distribution of orbits would give a substantially continuous service and fulfill the need for a broad-band transoceanic telephone and TV service. The same satellite would be useful in other parts of the globe, such as from America to Hawaii and the Philippines, from England to Egypt, India and Australia, and from South America to Africa and Antarctica.

A repeater for this kind of service need transmit only a fraction of a watt, from a non-directional antenna, and therefore need weigh only a few tens of pounds. Such a repeater design would be very simple and straightforward if it were to be used on earth where it could be serviced. Putting one in the sky is quite a different matter. To be practical the repeaters should be highly reliable for perhaps years of continuous operation. This is a difficult accomplishment for apparatus maintained in a controlled environment but looks extremely formidable for apparatus which must stand high accelerations and live in a poorly understood and perhaps hostile environment. It will take time and lots of effort to realize such an active repeater service.

Passive repeaters might offer a more immediate solution. The simplest broad-band repeater imaginable consists of a spherical reflector—a metallized balloon. A few large ground stations at carefully chosen locations equipped with large microwave transmitters and giant steerable antennas and MASER amplifiers can, by reflecting radio signals from orbiting mylar balloons, serve the whole world with broad-band communications.

A 100 ft. diameter balloon of .001 inch metallized mylar weighs considerably less than 100 pounds. It may be inflated with a small fraction of an atmosphere of gas pressure and the inflation maintained even in the face of micrometeorite perforations with a small quantity of low vapor pressure material such as moth balls or by electrostatic repulsion. It has the advantage of unlimited bandwidth and perfect linearity, and uses half as much frequency space in repeating a signal. It does, however, require much larger ground terminal facilities than the active repeaters. The National Aeronautics and Space Agency (NASA) has announced plans for erecting such balloons for air density measurements, and giant balloons of metallized mylar have already been built. Some experience with this kind of satellite therefore should be available shortly.

The 24-Hour Satellite Repeater

One of the disagreeable features of repeaters at a few thousand miles altitude is the fact that they must be acquired and tracked as they streak rapidly across the sky, and the very large ground antennas must be capable of switching rapidly from satellite to satellite to maintain a continuous circuit.

A most exciting prospect, therefore, is the possibility of the 24-hour repeater which remains stationary in the sky. With such a satellite, stationary ground antennas can be used and only three satellite relay stations are required to serve most of the world.

To be truly stationary with respect to the ground, the satellite must be very precisely placed in an equatorial orbit, 22,300 miles above the ground. Because of the greater distance it must radiate much more power toward the earth, and therefore will very likely by an active repeater with directional antennas weighing hundreds, or perhaps thousands of pounds. Signals relayed from such a distance will be delayed a quarter of a second, which is noticeable but not really objectionable.

Establishing such a repeater station will be a scientific achievement of very high order, and yet the time when it can be accomplished may not be many years away.

At first, 24-hour repeaters will probably be of low power and useful only for point-to-point communication between very large ground stations. Eventually, as space becomes more fully conquered, one can imagine very powerful repeaters with large antennas capable of interconnecting multitudes of small mobile ground stations. The impact of such a facility upon tactical warfare can scarcely be imagined. By use of small directional antennas which can be pointed to a known part of the sky it will be possible for aircraft, submarine or mobile troops to communicate with headquarters through the satellite repeater. It may be that the most important part of future warfare will be the maintenance and defense of such satellite repeater stations.

There may well be 24-hour passive satellites, but they will not be spherical, because even with the best conceivable ground equipment a sphere would have to be many thousands of feet in diameter and weigh tons, and, as if that were not enough, it would be violently disturbed by pressure of the sun's radiation. Planar, or less curved, reflectors are much more efficient, however, and could return a useful signal to earth. For large traffic point-to-point communications the passive 24-hour satellite might well be used, for although it offers a much weaker signal, it has no limit in bandwidth, cannot be saturated with too much signal power, nor jammed by enemy radiation.

The Ultimate System

How far dare one go in predicting space communication? A few years ago it was a subject forbidden to conservative minded people, discussed seriously only by a few imaginative and uninhibited individuals. Today a few bits of coded information are actually transmitted, and garbled speech is carried by satellites, but the subject is still in some disrepute because of the extravagant claims of the more daring prophets. Yet science speaks for itself and one can foresee some imminent possibilities.

It seems almost assured that a narrow-band message carrying service will come into being shortly. The only serious question about it is whether the possible secrecy advantage and additional message capacity of such an arrangement over present teletypewriter service will justify the expense of erecting and replacing low altitude satellites.

Intermediate (1,000 or so miles) altitude repeaters providing transoceanic communications between large satellite tracking communication terminals which are connected with existing telephone and television networks are farther away but technically feasible. It very likely will be an accomplished fact within a few years. Whether or not the relays are active or passive depends critically upon the development of long-life satellite components, the relative economics of rocket vs. ground station cost, and questions of reliability in the presence of man-made interference, both intended and unintended. There are as many well considered opinions as to the outcome as there are possibilities.

Twenty-four-hour satellites seem much further in the future, depending seriously upon the development of propulsion, accurate guidance, altitude control and reliable electronic components. None of these appear difficult compared to what already has been accomplished, but it will take considerable effort. Eventually, however, it seems certain that 24-hour wide-band satellites will be used for many applications; for long-rang round-the-world trunks, for aircraft control, military tactical communications. Some even dare predict that the 24-hour satellite will be an ideal switching center for world-wide communications.

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1,250,000	125	0	PHILCO REPORT, Feb. 10, 1959
16,000,000	10,192	2	WJCC REPORT, Feb. 1957
8,640,000	8,000	2	PHILCO REPORT, Feb. 12, 1959
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positive control of the electromagnetic spectrum

by
COL. J. D. FLASHMAN
Chief,
Frequency Allocation Group
Directorate of
Communications-Electronics
Hqs. U. S. Air Force

NOT SO MANY YEARS AGO the electromagnetic spectrum was a vast, unexplored region in the electronics field in much the same way that space represents an unexplored region to the field of astronautics today. From the early spark gap emitters which operated in an era when there was little or no requirement for control of frequencies or emissions, we have progressed through many phases of modification and improvement which have permitted a wider variety and multiplicity of uses of the spectrum. Bandwidths of emission have been narrowed, tolerances have been improved, and the frequency spectrum has been managed more and more efficiently through national and international regulation. Through the processes of regulating spectrum utilization has come the recognition that certain services require greater protection, or freedom from harmful interference in their use of the spectrum, than other services. The Maritime Mobile Service came into being some fifty years ago. International recognition of the Aeronautical Service was achieved in 1938. The latter, by reason of its close relationship to safety of life and property, required a distinction in frequency allocation tables from other services, such as fixed communications where interference would not ordinarily threaten potentially disastrous consequences as in the case of aviation.

Now the world is on the threshold of a new age, the Space Age, and few will question the enormous extent to which success or failure of our efforts in the space field will be dependent upon communications and electronics and, more specifically, upon the role which the electromagnetic spectrum will play in our endeavors.

By coincidence, and it appears an extremely timely one, the nations of the world are now preparing for an international radio conference to be held in Geneva later this year. This conference will take place just at a time when the need for adequate frequency provision for *space activity* is becoming keenly felt. The Atlantic City International Radio Regulations of 1947, make no provision for this type of service. While it is not possible at this time to make known specifics of U. S. proposals for the radio conference in regard to space communications, it is appropriate to point out that we will seek to provide for this service a number of bands of frequencies widely dispersed through the spectrum. The exact locations of these are predicated primarily upon such factors as propagation and equipment development and are influenced to some extent by existing spectrum occupancy. Although there is as yet little concrete information regarding the views of other governments in this respect, it may be assumed that there will be proposals from administrations other than the United States which will also recognize space communication as a new service deserving of accommodation and protection. Thus, it may reasonably be hoped that at the conclusion of the Geneva Conference, the nations of the world will have produced at least the framework of new regulations embracing within them, for the first time, provision for space communications. *The big question which then arises is, once we have these bands, what are we going to do about protecting them?* "Protecting" in this instance means insuring that they are at all times, not just reasonably free from interference, but *positively clear*, in a sense not even approached in our present-day concept of spectrum utilization. We now accept *some* degree of interference to all of our communications. In the land mobile service, for example, spectrum congestion is so heavy that interference is recognized as normal and merely results in a small but acceptable communications delay. The aviation service is somewhat more sensitive and, although interference is experienced, efforts have been, and are continuously being, made to assign more and clearer channels in order to eliminate or minimize communications delay and confusion. This statement may give rise to some questions based on individual experiences. However, it can be shown that for traffic control purposes, where safety of life is the fundamental issue, great improvements have been made.

Now, to bring the picture a little more up to date. In our efforts thus far in missiles and rocketry, unintentional interference has, of course, been recognized as a potentially serious hazard to operations and we have taken steps to minimize its impact. Area frequency coordinators at missile test sites, for example, have the responsibility and authority to insure a reasonably interference-free environment before an operation is permitted. "Countdowns" can be, and sometimes are, delayed because of interference. Although there may be misgivings regard-

ing the extent to which a frequency coordinator can provide an interference-free environment, by and large the system has worked reasonably well thus far. This has been so largely because the area within which experimental vehicles have been dependent upon air-ground electronic links has been limited generally to the area within which the coordinator can reasonably gage, predict and control the environment. As we concentrate further and further on outer space, however, success or failure of our operations becomes more and more dependent upon an *absolutely guaranteed* interference-free environment. Proportionally, also the magnitude of the environment expands until it far exceeds the area which a coordinator could hope to control from his limited laboratory-like station. Finally and most importantly, as our efforts become increasingly ambitious, the opportunity for a second chance becomes proportionately less. The first try must be a success, otherwise lives may be lost, millions of dollars may have been expended wastefully, to say nothing of the loss suffered by national prestige. We must be able to track space vehicles accurately, observe their programming and record their data transmissions in the most minute detail and inject control and guidance instructions instantly at will. Even recognizing that we are dealing here with signal levels so infinitesimal as to be almost incomprehensible, it might be argued in some quarters that there is no real problem; "simply allocate adequate space for the service, and the problem will take care of itself." This approach may seem reasonable in theory; but when viewed in the light of the radio spectrum *as it exists in reality*, such an argument is as naive as it is frightening.

Under concepts by which the frequency spectrum is now used, it is just not possible to *guarantee* that any portion of the spectrum will be interference free, regardless of national or international intentions or agreements. Controls which would make this guarantee possible simply do not exist. Internationally recognized distress frequencies are probably among the most sacred assignments known, yet these frequencies are seriously abused, not just occasionally but continuously as monitoring reports readily disclose.

Let us examine, for a minute, some of the factors which contribute to the absence of positive control over the use of the electromagnetic spectrum. Any administration, from an international standpoint, is free to assign and use any radio frequency it wishes, providing such use is in accordance with regulation, or that harmful interference is not caused to other administrations which *are* using the frequency in accordance with regulation. Suppose an administration wishes to use a frequency not in accordance with accepted regulations, and interference results from such use. The normal consequence is, first, an exchange of notes on a technical level between administrations. If this is not successful it may be followed virtually as a last resort by an exchange of notes at the diplomatic level. In the meantime, of course, much damage may have been done and, in the case of a sensitive service, this damage could well have been disastrous. Looking at the picture from a national standpoint, an individual, for example a radio amateur, is authorized to use certain bands of frequencies in accordance with restrictions imposed by his license. There are penalties of course for violation of the terms of the license but, as a practical matter, it has not been necessary or possible to police the operations of each amateur to the extent of insuring that all restrictions are observed to the letter. The average amateur has little, if any, knowledge of the *total effect* throughout the spectrum of his radiations once he turns on his transmitter. He is concerned with the effectiveness of his primary radiation and any by-products he might unknowingly create, he will gladly take care of if and when they are brought to his attention. This is by no means intended as an indictment of the amateur radio operator. Certainly not—he is an intelligent law-abiding citizen who practices his avocation in accordance with all the customs, traditions and dignity of his fraternity. This is cited merely as an example of "After the Fact" rather than "Before the Fact" corrective action. The same situation prevails in the case of the radar operator, and, if anything, to an even greater extent. The average radar station is not equipped with instrumentation necessary to permit operators, no matter how diligent they may be, to accurately gage the *total* effect of their emissions on the spectrum or to insure that their station is, in fact, being operated even approximately in accordance with prescribed limitations. The electronic environment in the vicinity of a radar station can be, and frequently is, totally changed from one minute to the next merely by a routine adjustment or the replacement of a magnetron.

Because in the past, ways and means for achieving effective control have been absent, it by no means follows that this situation should always be so. Corrective measures can be taken. Admittedly, considerable expense and loss of freedom will be involved; however, once the problem is recognized and its solution accepted as necessary, then the only major obstacle remaining is the acceptance of initiative for action.

It might be appropriate to cite some examples of fields wherein the evolutionary process leading towards positive control has been successfully carried out. We all accept today the fact that the service we receive from a public utility will be, to the extent of human ability, exactly in accordance with prescribed standards. Aids to navigation are relied upon to provide precisely the service for which they are intended, no more, no less; and, to this end, such facilities are subjected to constant police surveillance in the form of routine checking, both on the surface and in the air. The control of air traffic, which not so long ago was non-existent, is rapidly becoming recognized as mandatory and is being enforced. To this list of fields which have gradually adopted standards of positive control should be added a new one—control of the use of the electromagnetic spectrum. Without positive control, virtually all our activities in space communications and electronics will be conducted in an atmosphere of calculated risk, subject to the whim of the negligent, inexperienced or inept co-user of the spectrum, within whose power it is to wreck completely an operation upon which the prestige of an entire nation may rest.

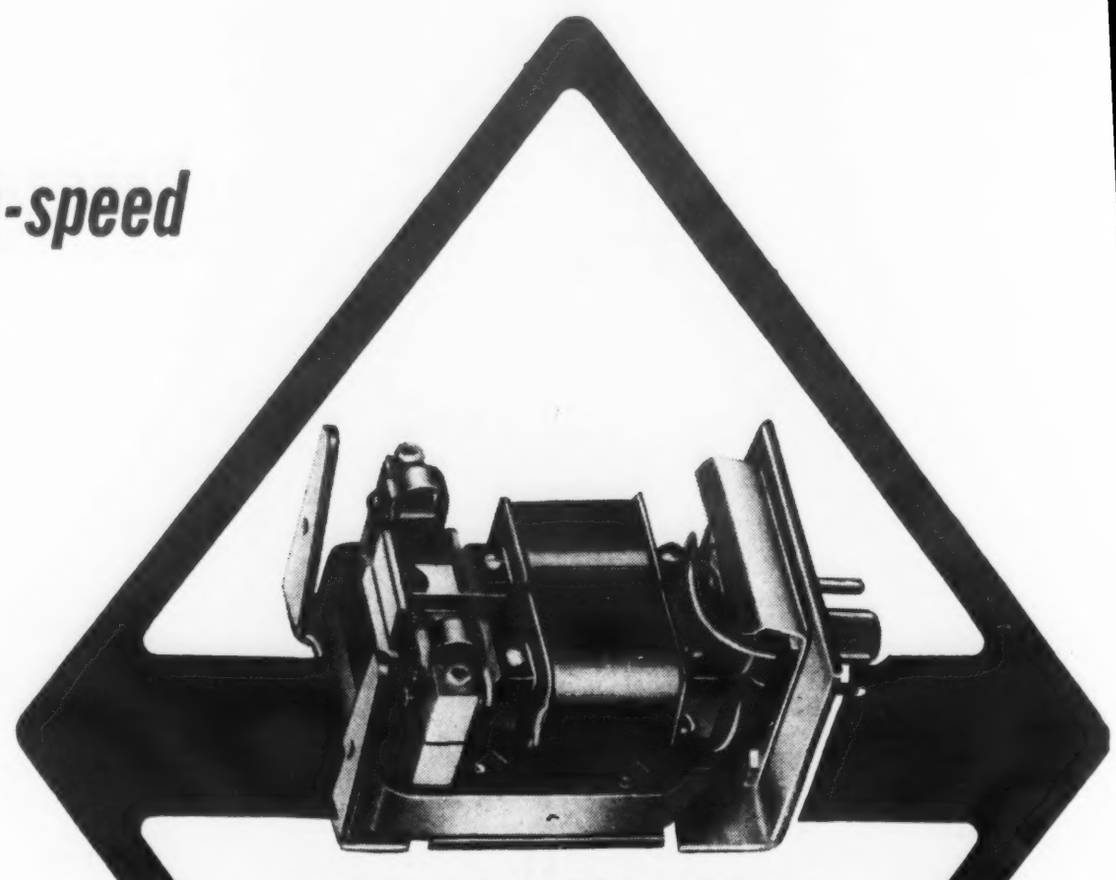
It is not intended here to discuss in detail steps through which such positive control may be achieved. There are in existence consultative and advisory groups well equipped to lay the foundations upon which tight regulatory provisions may be based. It would be reasonable to assume, however, that early in this evolutionary process there would appear the requirement that a spectrum user must at least be equipped with the tools necessary for him to gage precisely and continuously the total effect of his radiations upon the electromagnetic spectrum.

In conclusion, it might be pointed out that as dramatic and successful as recent space activities may have been, their success has by no means been a foregone conclusion from a frequency usage standpoint. Success in the future cannot be assumed as long as there exists the element of calculated risk of electronic interference. The job now confronting us, therefore, is the elimination of all risk—in short, positive control.

Small...sensitive...high-speed

POLAR RELAY

for billions of maintenance-free operations



New Type 204 Series PTW Polar Relay has octal plug mounting for universal use. Height, $2\frac{13}{16}$" plus $\frac{41}{64}$" projection of mounting plug; width, $2\frac{9}{32}$" x $1\frac{11}{16}$". Type 202 has standard banana-type terminals; Type 203 has pin-type terminals.

HERE'S A 2-position Polar Relay that can be depended upon for switching a single circuit at high speeds through billions of operations—*without readjustment*.

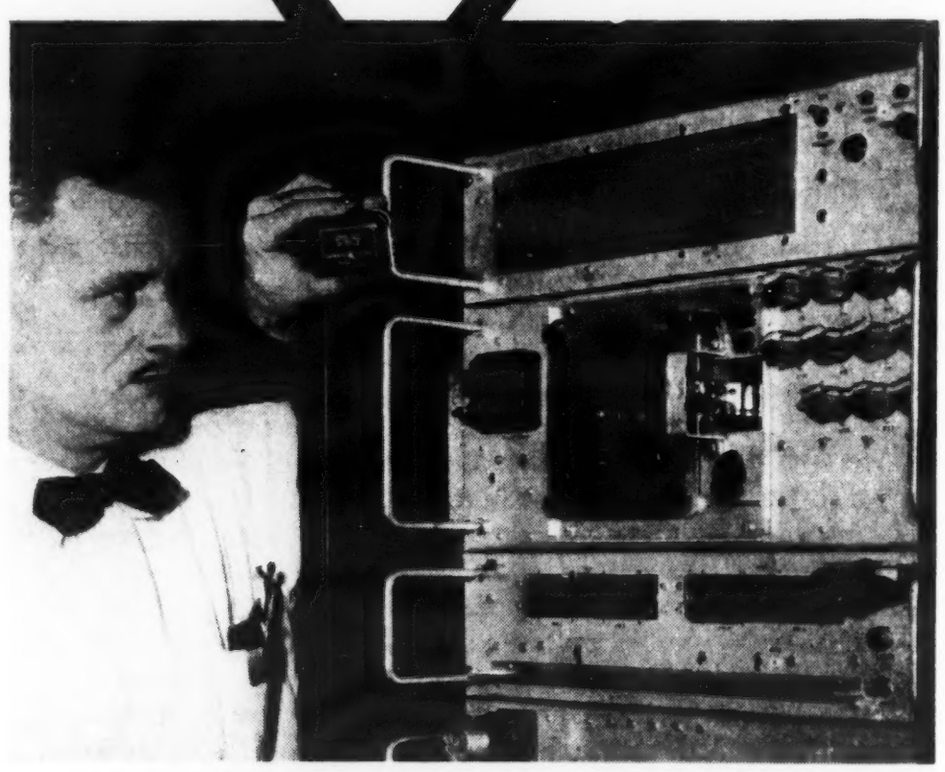
Substantially smaller than other polar relays, the Automatic Electric Series PTW is designed for telegraph and teleprinter circuits—teletypewriter switching—teletypewriter repeater circuits—plus other industrial and military applications. Type 203 is completely interchangeable with Western Electric 255A relays.

Check these unique advantages

Because of its simple design and compact construction, the PTW costs substantially less than other relays you may have been using. It delivers lightning response (travel time as little as 0.7 of a millisecond!). And its design assures adjustments that stay put practically forever.

Series PTW Polar Relays are available with various type terminals to fit both new and existing applications—including surface mounting of Type 202 in replacement of Western Union Type 17 relay.

For full information, call or write Automatic Electric Sales Corporation, Northlake, Illinois. *In Canada:* Automatic Electric Sales (Canada) Ltd., Toronto. Offices in principal cities.



Automatic Electric Polar Relay is used in selector cabinet of Teleregister Corp. stock-quotation system. Teleregister design engineer, Jim Hartelius, shows how snap-on cover can be removed for visual inspection. He reports " . . . complete reliability . . . almost infinite life . . . virtually never gets out of adjustment."

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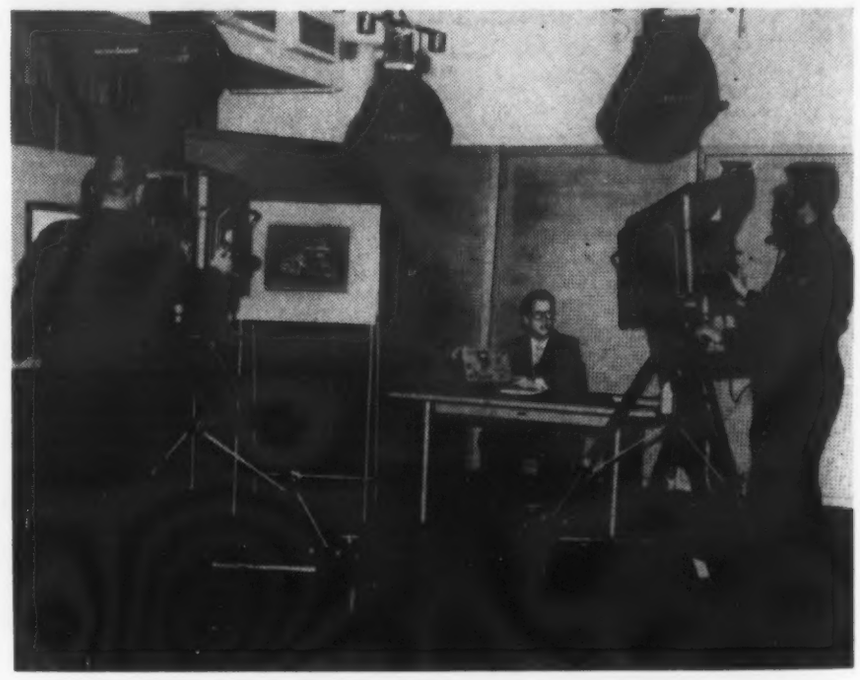
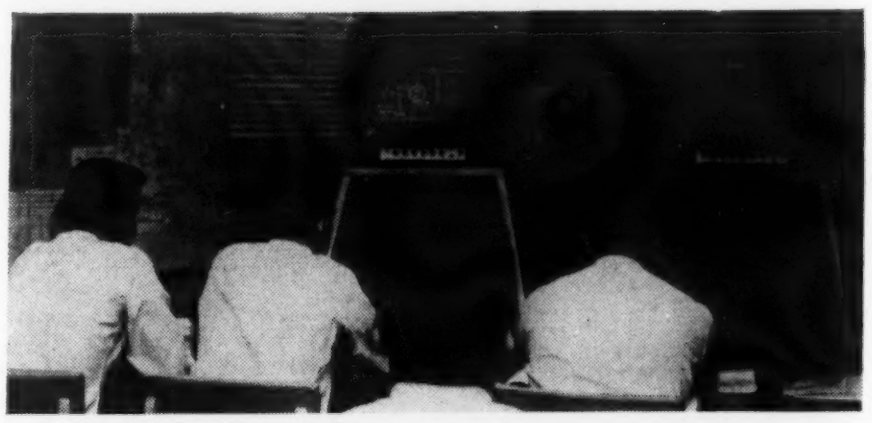
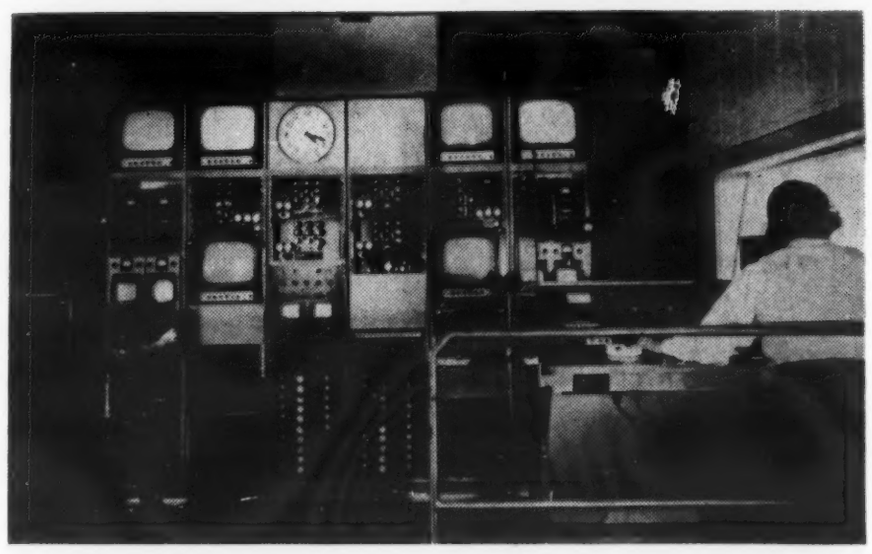
Subsidiary of GENERAL TELEPHONE & ELECTRONICS



Lowry Air Force Base uses stereo tv system for training technicians

by
PAUL A. GREENMEYER
Managing Editor
RCA BROADCASTING NEWS





Top: This is Teaching Studio No. 1. One camera is focused on the trainer, the other on the chart. Middle: A typical classroom at Lowry AFB where classes average about five students. By the use of two receivers simultaneously, students do not have to search for the circuit diagram in their textbooks. Bottom: TV Film Room—Here are located 35mm and 16mm projectors and TV film cameras. The director pushes a switch to put films on the TV receiver.

UNDER General Eugene P. Mussett, Lowry AFB has had a continuing program for improving its training course. As a result of keeping track of graduate students, the course material has been perfected and instructors better prepared. TV is now helping in this program, enabling instructors to present course material in the very best way.

The aim of the courses is to prepare maintenance mechanics. The main subjects of instruction are technical, involving a great deal of electronics. Typical subjects are maintenance of: fire control systems, gunnery, guided missiles and bomb-navigation systems.

The TV project is used, for example, to train bomb-navigation systems mechanics, a course consisting of 720 academic hours of training and 30 non-academic hours, a total of 750 hours. It's a 27-week course including one week basic training, two weeks leave, and twenty-four weeks of academic instruction. The course is divided into eight blocks of instruction:

I	Principles of Electricity	72 Hours
II	Principles of Operation of Electronic Components	78 Hours
III	System Data Flow	180 Hours
IV	System Power Distribution	30 Hours
V	Radar and Interconnection Equipment, Front Panel Adjustments	60 Hours
VI	After Installation Checks and Adjustments	90 Hours
VII	Computers, Stab and Optics Troubleshooting	108 Hours
VIII	Radar, Ice and Complete System Troubleshooting	102 Hours

The class day is divided into two three-hour periods. In the morning TV is used for three hours of classroom instruction. This is followed by three hours in the lab. Break and stretch periods are inserted so that TV is not used continuously for more than 30 minutes.

ETV Ideal Medium

It has been found that teaching is made easier and the learning process speeded. The students see large, close-up views of charts, tools and demonstrations. This enables the instructor to get his point across. It's an ideal one-to-one relationship between student and instructor.

It has been found, for example, that TV is a natural for teaching fundamentals of electronics. Diagrams and meters are clearly seen. Reading of technical orders is speeded. Use of tools is clearly illustrated. Every student gets a front row seat; there is no crowding.

Each classroom has two receivers because two TV channels are used. Thus, students can observe a separate picture on each. For example, a trainer can be shown on one receiver and the corresponding electrical schematic on the other. This enables the student to make comparisons between the two. It speeds the learning process.

The front view of a component can be shown on one monitor, and a side view can be shown on the other monitor to help the student visualize the equipment.

Both channels need not be used continually. At the director's discretion, one channel can be blanked out and a single channel used, as is done in conventional TV. An additional advantage is that programming can be shifted, in event of trouble, to the other channel, without interruption of the teaching.

Students can ask questions of the TV instructor and receive answers back. This is arranged to operate through a proctor in each class, who passes the microphone to the student having a question, then pushes the question button. The instructor sees a lighted number under his

(Continued on page 51)

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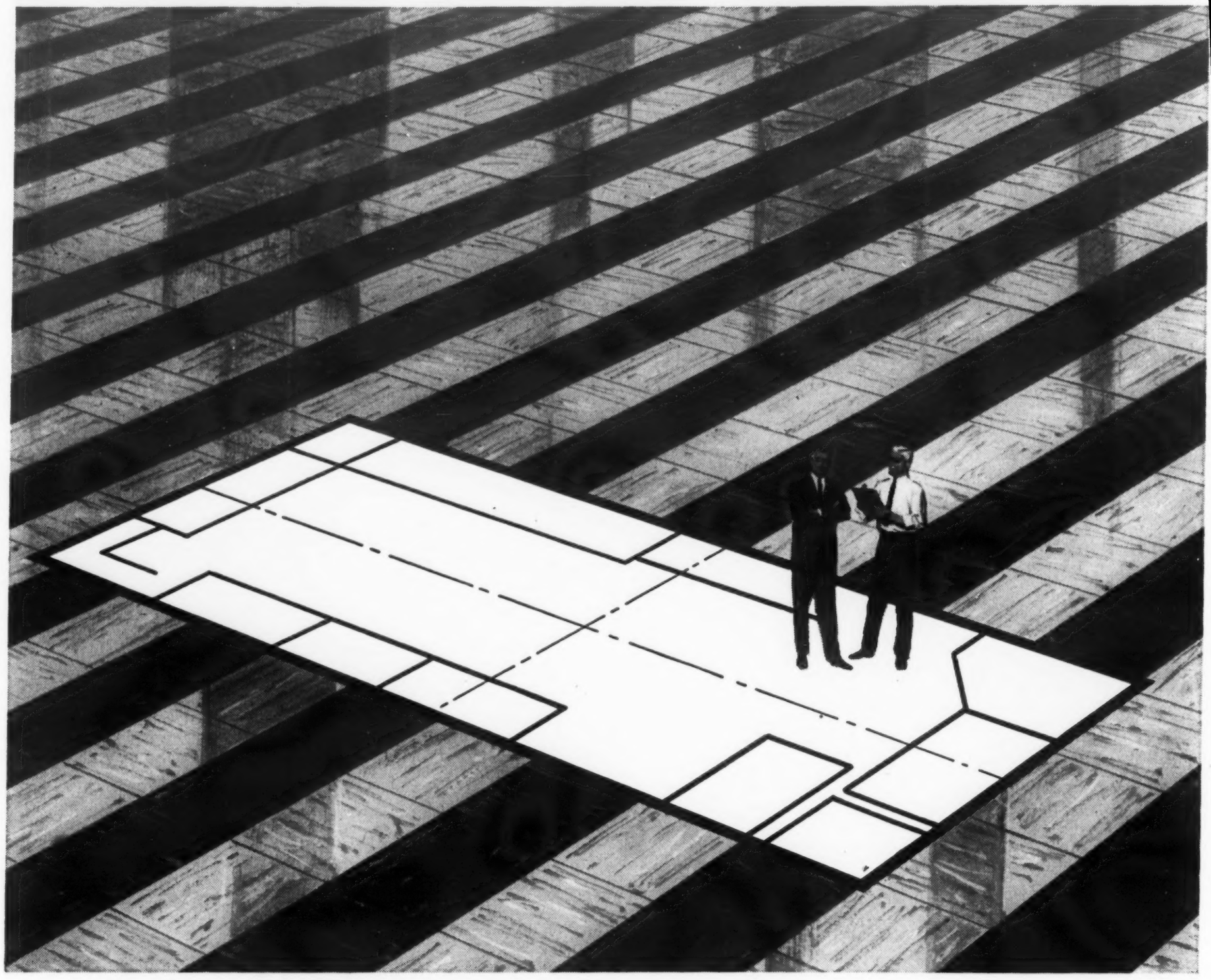
Type No.
H-20
H-21
H-22
H-23
H-24
H-25

Type No.
H-80
H-81
H-82
H-84
H-89

Type No.
H-121
H-122
H-125
H-130

SYLVANIA SYSTEMS . . . **IN COMPUTERS**



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This mobile digital computer, designed and built for the U.S. Army Signal Corps, operates at speeds never before available in any general-purpose computer. It's capable of performing, in less than 2 hours, complex data processing problems which previously required up to sixteen hours.

It's fully transistorized and packaged to fit in a 28-foot trailer. What's more, it can be installed anywhere without special site preparation and requires no equipment air conditioning.

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(Continued from page 49)

studio monitors, indicating class where question originates and, when he is ready, asks for the question. Discussion then goes on back and forth until students are fully informed. All the classes hear both sides of the discussion. In this way the instructor maintains personal contact.

Instructor-Director Team

It has been found that the ideal combination for teaching via TV is a team approach. Cameramen, floormen, instructors, video directors and operators rehearse together as a complete team. The director sits at the control desk, giving directions to all on the team; also switching pictures. The cameramen move about as directed, focusing on instructors, equipment, diagrams, demonstrations, etc. The floormen get charts, diagrams and equipment in place before the camera.

The instructor and director act as a two-man teaching team. Directors are instructors and vice versa; they alternate with each other. One teaches for three to four days, then directs for the same length of time. In this way the direction and switching are always under the control of one who is essentially a teacher. And, the instructor receives continuous guidance and support from a fellow instructor as he is making his presentation. This makes for maximum effectiveness in training.

The floorman and proctor form a similar studio production team. This leads to training of future TV instructors and directors.

Classes are small, averaging 15 students each; they are subdivided into smaller 5-man classes, and a proctor is employed to supervise and assist each of these classes. (These proctors are apprentice instructors who display aptitude for developing into TV instructors.) The total student load is theoretically limitless.

TV Makes Expansion Easy

Additional students are being added at the rate of 45 per week compared to a former rate of 5 per week. This large increase is a staggering load under conventional teaching, requiring 120 additional instructors. But with TV this increase can be easily handled. It is only necessary to install additional receivers, with only a minor increase in TV instructors being required.

The expansion capability, built into TV, makes it a relatively simple matter to handle additional students. Two shifts and two studios are being run to handle the influx. Since there are three hours of TV instruction per shift and studio, this means 12 TV hours per day.

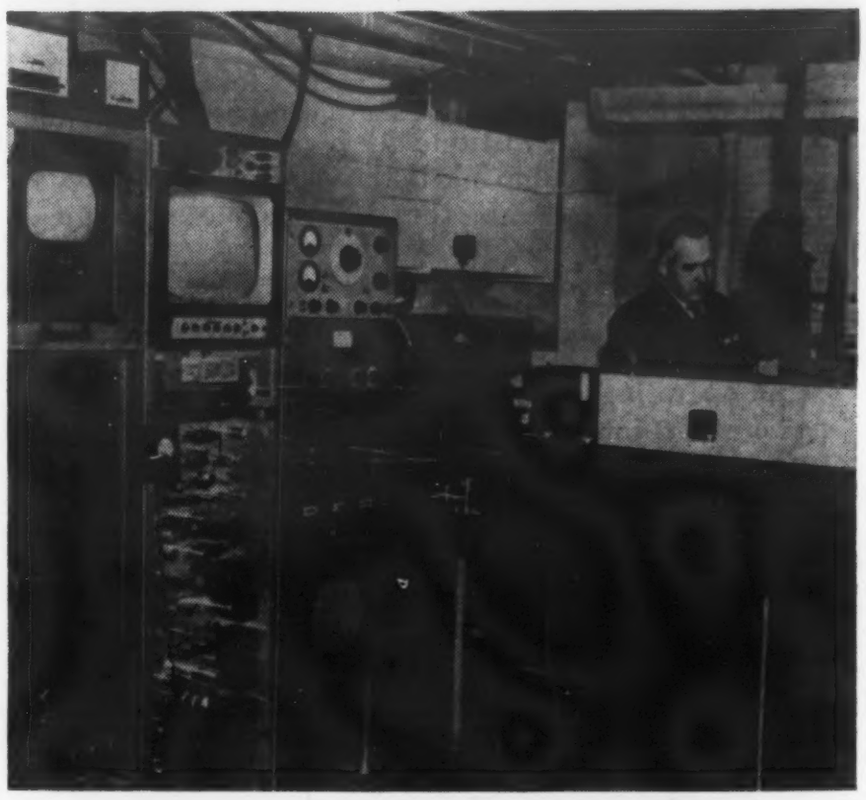
Power of TV Teaching

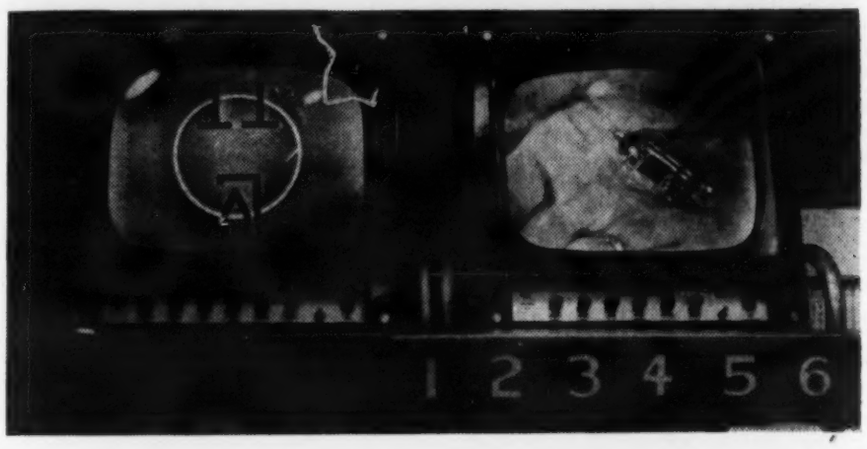
Since the TV camera can be focused on exactly the area desired, the students see exactly what the instructor wants them to see: close-up of a meter, showing needle movement and meter readings; close-up of a CRO tube, showing the trace on the face of the oscilloscope; hand adjusting controls on a complicated piece of equipment.

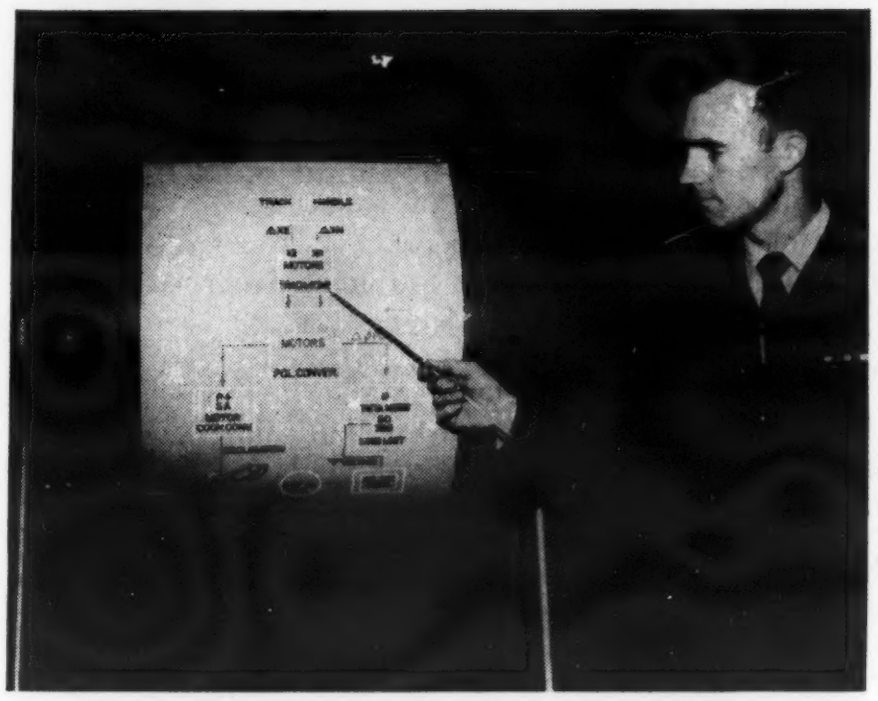
Consequently, the students are not distracted by things of incidental interest that are of no consequence to the subject under discussion. The instructor deliberately removes from the students' eyes those portions of the equipment or circuit diagram not essential to the lesson. Hence, attention is concentrated on those items that pertain to the lesson.

Training TV Personnel

In order to achieve top operating efficiency of the whole TV team, certain functions are paired. Cameramen, for example, also serve as maintenance men and vice versa. They act as maintenance men for a period,







(Top) TV Control Room — Monitors and switching equipment are located here. At right is the director who works with the instructor. The director gives directions to the cameraman through an intercommunications system and can see directly into studio No. 1 through the large picture window at right. (Middle) These are monitors in teaching studio for showing instructor exactly what the class sees. Note small tube in instructor's hand (at right) while diagram for this tube appears at left. The numbers in front of the monitors indicate classrooms and light up to tell the instructor where there is a question from a class. (Bottom) This is a crawl (or drum), which is designed to handle large diagrams; the student sees only the part being explained.

then serve as cameramen at a later period. As a result, the cameras are usually in very good operating condition. The floor managers and the proctors are likewise paired. Both these functions constitute ideal training for future TV instructors. And having both worked together with the instructor-director team, they help make the presentation more effective.

Since there is no reservoir of qualified personnel, Lowry TV Administration has made plans for training its own personnel.

In the operating area, for example, the film room personnel develop into maintenance men. As they become more proficient, they advance to camera operator and then to video operator, sitting at the controls of the TV cameras. Advancement of this sort provides incentive to the airmen and provides the TV Administration with trained people.

Simulates Actual Experience

It is possible to give the classroom student in-flight effects by the use of television. For example, the illustration of cross-hair drifts, caused by wind, is achieved by superimposition. This effect requires the use of two cameras, superimposing one picture on the other. One camera is focused upon an aerial view of the earth, to provide the background picture, the second camera is focused upon cross-hairs. By moving the second camera, the student receives the illusion of an aircraft moving over the face of the earth.

Procedures that can ordinarily be viewed by only one student at a time, can be seen by all students at the same time when TV is used. For example, consider a typical alignment procedure, requiring the use of an eyepiece. This effect is achieved by the use of 2 cameras and 2 slide projectors. Camera No. 1 is focused on No. 1 cross-hair. Camera No. 2 is focused on No. 2 cross-hair. Slide Projector No. 1 is focused on No. 3 (fixed) cross-hair. Slide Projector No. 2 is focused on typical background. To give the correct illusion, cameras 1 and 2 are moved about (to simulate typical adjustments) until movable cross-hairs are lined up with fixed cross-hairs. This indicates that vertical and horizontal adjustments have been correctly made. The entire class sees this effect, greatly enlarged on the TV screen as the instructor explains the operation. This saves a great deal of time and effort, and also provides a dramatic reproduction of the actual process.

Better Student Response

According to Master Instructor Van Gilder, an instructor, specializing in teaching the fundamentals of electronics, TV teaching is a tremendous aid to the instructor. He can give the student experience with problems; instead of one experience, it is now possible for each student to receive three experiences with each problem in the same amount of time. Further, the instructor finds that the student response is increased. This is indicated in the nature of the questions and the increase of spontaneous reaction. It is also felt the competition of one class against the other, encouraged by the TV teaching system, produces greater student participation and awareness.

Lowry's plan for introducing new students to the TV teaching system is credited with a great measure of success. Student orientation takes place via TV itself. First, an address by the Administrative Officer is made over TV. Then follows a tour of the TV facilities: Students see equipment, TV studios and the classroom. They are encouraged to ask questions and operate the equipment. Thus, they develop keen interest in the system.

Graphics Aid TV Teaching

Numerous devices created by Lowry TV Administration officials have contributed considerably to the effectual use of TV for teaching. Charts, trainers and demonstration units have been designed and constructed. Holders for flip cards, roller boards and crawls have been built by Lowry personnel. These reveal the enthusiasm that instructors and administration personnel have for the TV medium.

Consider the roller board. This is, in effect, a substitute for a blackboard. It eliminates the messiness of chalk, since a grease pencil or felt tipped pen is used on white paper. No wiping is required to remove marking, the instructor merely turns a crank, and a new, clean surface appears. However, the original is always available for reference since it can be returned by a reverse turn of the crank. It is all done by using a large roll of paper which travels from one roller to another, vertically, by means of the crank. This simple apparatus is mounted on the rear of 3 by 3 ft. boards. A square section 12 by 12 inches is cut into the middle of the board. It is upon this area that the instructor writes. The whole affair is mounted in a tubular metal frame that can be moved about the floor of the studio. This unique device was built by Lowry's Training Aids Department.

Slides and movie films can be integrated into the instruction program directly from the TV film room. These vital aids are set up in advance and noted in the script. Then the director inserts them at the proper time by pushing a button on his switcher panel. There is no distraction, such as conventional methods cause, by setting up and running a projector in the classrooms. In the TV class, the picture on the screen simply changes from that of the instructor to that of the visual aid. These aids provide valuable adjuncts to teaching. However, in the case of slides vs. charts, the instructor of technical subjects seems to prefer the latter. This is because the chart is located in the studio and is directly under the instructor's control. He can point out the item under discussion on the chart, follow a circuit diagram by pointer, make marks and otherwise pin-point his subject.

Three Benefits from TV

Colonel Jack W. Hughes, Lowry's Center Operations Officer, who is personally guiding the TV Training Project, has this to say about ETV: "We are reaping three major benefits in our teaching program.

"First, we are utilizing our qualified instructors to better advantage. They can be used to teach many more students than in the conventional way. Hence, the 20% of our instructors who are fully experienced and qualified are carrying 100% of the teaching burden. The remaining 80% are training through observation.

"Second, insofar as course material is concerned, we are able to exercise more definite control. Course content is closely scrutinized. The required rehearsals enable us to preview and perfect our course before presentation.

"Third, with respect to the student, we believe that we make it easier for him to learn the significant parts of the course. Every student sees and hears exactly what the instructor chooses. There is no distraction, no inability to see. He achieves the closest to a one-to-one ratio that is humanly possible."

According to General Mussett, the use of TV results in more rapid training and better trained men and also provides the most effective utilization of instructor personnel. As a result there is envisioned an orderly expansion of TV to cover the entire base. Preparation for future training programs, is also underway.

From Crosley... Command Receivers for Drones and Missiles

Designed and manufactured by Avco's Crosley Division, Command Receivers are standard equipment aboard most of the nation's missiles. Their job: To receive and act upon instructions from the ground to destroy the missile when its flight path indicates the missile has gone awry.

In a missile configuration, the Command Receiver weighs only 12 pounds, has three channels and incorporates a decoder and power supply in a simple pressurized package.

A second version of the Command Receiver, employing 12 channels for radio communication, is used in high-performance drones and decoys. In such applications, the Command Receiver actuates control surfaces, directs engine operation and opens the recovery parachute—all by radio-conveyed instructions from the ground.

A Product of Crosley Engineering, the Command Receiver has proven itself for the future by the job it is doing in the missiles and drones of today.

For more information, write to: Vice-President, Marketing-Defense Products, Dept. S-59, Crosley Division, Avco Corporation, 1329 Arlington Street, Cincinnati 25, Ohio.

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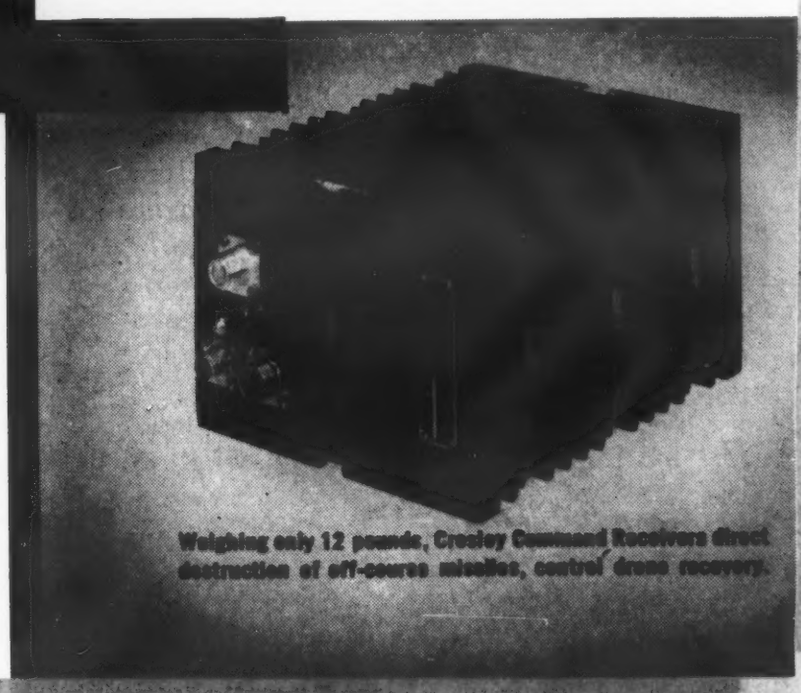

Weighing only 12 pounds, Crosley Command Receivers direct destruction of off-course missiles, control drone recovery.

by REAR ADMIRAL JOHN S. THACH, USN
Commander, Hunter Killer Force
United States Atlantic Fleet

anti-submarine warfare—a national problem

As Commander of Anti-submarine Defense Group ALFA, the problems of anti-submarine defense are my daily concern. They are great but not unsolvable. It is encouraging to me to see industry making efforts to arrive at solutions which are vitally necessary for our nation's security.

The effort exemplified in the recently developed Stromberg-Carlson Sonar test tank at Rochester, N. Y., represents a departure from a philosophy so often run across which stymies progress. This is the idea that a given piece of equipment is a closed book. "Sonar is sonar, and that's that. If we want to do the job better we'll have to make a new and startling discovery somewhere else." Nothing could be further from the truth. There is not one single piece of our anti-submarine warfare (ASW) equipment which cannot be improved and sonar is still a most promising field. There are many paths for ASW research and development to follow and some of these just might help us tremendously. But the day we start sitting around on our hands waiting for the "Big Breakthrough" to come along and solve all our problems, that is the day we're in serious trouble.

Another thing of importance about the test tank mentioned above is its *underwater* research capability. After 40 years, submarines are finally approaching the true submersible and the closer they get the tougher anti-submarine defense becomes. The day of catching submarines on the surface with radar or the MK I eyeball is almost gone. Submarines are exposing less and less above water. They are going deeper and deeper and they are staying down longer and longer. In order to beat them, we have to be able to find them. That means we are going to have to go down underwater after them. This test tank is a big step in the right direction.

We have been using the term "submarine" for years now, but what we have really been talking about is a surface vessel that could submerge temporarily. As a matter of fact, submerging was actually a necessary evil, used only when absolutely necessary. The minute the sub went down her speed was cut in half. Her range was severely restricted and in a matter of hours she was out of battery and gasping for breath.

The famous German "Schnorkel" of World War II has given the sub a tremendous advantage. With a snorkel, she can stay down and use her diesel engines almost indefinitely, without depleting her battery and with only the tip end of a stove pipe exposed.

Now, with the advent of nuclear propulsion and the *Albacore's* revolutionary new hull design, we're suddenly up against a ship that can really stay underwater. Instead of a surface vessel that can submerge only temporarily, she's a submersible that only has to surface temporarily, long enough to re-enlist the crew, according to the submariners. The submarine's underwater speed and depth have been vastly increased. Her range is unlimited. Her endurance is limited only by the oxygen she can carry.

Such a submarine is a pretty tough customer. Fortunately, for us, the Soviet Union hasn't yet shown such a boat. But the Soviets never show a weapon until it is ready to be used. What they have shown is trouble enough. Current estimates of Soviet submarine strength run close to 450 ships. Most of them are new. They're fast. Snorkels are standard equipment. Nuclear propulsion is only a matter of time.

Now add to that threat another new development, the submarine-launched guided missile, and it is plain that our anti-submarine defense program must be greatly accelerated.

We're up against a triple-threat vessel, torpedoes plus mines plus missiles. Unfortunately she's not an All-American. Missiles aside — armed only with conventional mines and torpedoes, she constitutes a threat we cannot ignore.

That's because the North American continent is an island; oceans separate us from nine-tenths of the world's population including most of our allies. Arcing out from the United States are sea lanes, to every corner of the globe. These carry 99% of our total overseas tonnage — tonnages (equipment and supplies) which are the sinews of our Free World Alliances. Without them, our allies could not survive. Without them, our own survival is questionable.

Hitler started his war with about 60 U-boats, the old fashioned kind that could submerge only temporarily, and he nearly strangled us. The Russians have eight times that many right now. The number is greater than all the other navies in the world combined.

Unfortunately, airlift isn't a very satisfactory answer. Airlift costs about 40 times as much as sea-lift, per ton-mile. And even if we could get locomotives, trucks and printing presses into airplanes (and could afford it) for every ton of cargo we airlift to Europe, we first have to ship a ton of aviation fuel to Europe to get the plane home. It is evident that our security must depend on free sea lanes for many years to come.

Now on top of what the submarine can do to our vital shipping, add this new guided missile capability and the outlook becomes grim. A dozen Russian submarines, packing Polarises, could wipe out 70% of our economy in one surprise blow. Submarines have ceased to be the Navy's private little headache. Not one single square inch of the U.S. is more than 1500 miles from "submarineable" waters —and 1500 miles is just medium range for today's missiles. Most of

our population sits at point blank range, with only minutes early warning. Submarine missiles could be inside our air defense radars and on their way the instant they are launched. Our greatest need in ASW today is some sort of undersea early warning radar that can make the opaque oceans as transparent as the air.

Here's what we're up against. The ocean is our highway for billions of tons of commerce. It is the ancient buffer zone between the land masses that has insulated us by dark, silent, empty oceans, depths. Well, it's dark all right, but if you think for a minute the depths of the seas are empty or silent, any anti-submarine sailor can tell you you're in for a big surprise. It's a jungle down there. Whole mountain ranges are hidden a thousands fathoms below the surface of the ocean—so well hidden in fact that when *Nautilus* made her polar trip last fall, she discovered a whole range extending all the way up to the pole. Great gullies and canyons miles deep are gouged into the ocean floor. Hiding it all are millions of cubic miles of sea water, great murky masses of discontinuities full of sound ducts and current and inversions. Most incredible of all is the noise racketing around the undersea jungle.

Finding a submarine down in that jungle is a real "Who Dun It." There are 12 million square miles of ocean in the North Atlantic, thousands of fathoms deep. It's not even as simple as finding needles in the haystack—the haystack itself is against us.

Just like a detective, you have to pick up bits and pieces and clues and search down all the blind alleys before you can figure out where she might be, or if she's there at all. About the only thing you can be sure of is it isn't the butler.

These are our two big problems in ASW: *Detection*—finding her (or them)—and *Classification*—figuring out whether what we find is a whale, a school of fish, a bottom pinnacle, a figment of our imaginations or really a submarine.

Americans seem to like to rely on the Big Bomb. Well, we have an atomic anti-submarine bomb, which we can use under certain circumstances. But it's certainly not the answer to our ASW problem today.

In the first place, we can't vaporize a Soviet submarine going about her business on the high seas because we suspect she may be able to harm us. International freedom of the seas is one of our most emphatic American policies. Right up to the instant a submarine starts shooting at us, the high seas belong to her just as much as anyone else.

In the second place, in ASW an atomic bomb is just an expensive excuse for inaccuracy. You can destroy a submarine with a hole in her pressure hull the size of my hand. You don't have to vaporize her with an atomic bomb to defeat her.

What is more to the point, you can't even scare her with an atomic bomb if you can't find her. And you certainly won't slow her down any if you think you've found her and demolish a whale.

So we're right back to our two big problems—detection and classification. And these are the problems that must be attacked in this new test tank. We must have detection measured in miles instead of yards. We must have instant assurance that what we detect is indeed a submarine. We must be able to keep close tabs on millions of miles of ocean around the clock, seven days a week, in every area of the world where submarines could secretly position themselves for a surprise attack upon us or our allies. In short, we must be able to demonstrate a consistent ability to place our Big Bomb over every potentially hostile Soviet submarine, as the surest deterrant to hostility. We can't do that today.

However, the outlook is not all black. Our adversary is human, too. Her ability to see and hear is just as limited as ours. She must navigate. She must keep herself oriented down in that jungle. Above all, she is curious. She knows that one peek is worth two finesses and everytime she peeks she will sacrifice her greatest advantage, her stealth. And she is extremely vulnerable once she is caught. She's like a man on a tightrope and she can't afford a single misstep.

Task Group ALFA is learning how to capitalize on such mistakes and how to force the submarine into positions where she will make such mistakes. Ideally, each anti-submarine vehicle should have the ability to detect, classify, hold and, if necessary, kill submarines all by herself. This ideal condition has not yet been realized. Until it is, it is necessary to coordinate the use of all techniques, tactics and equipments available in order to keep the pressure on a sub. We have land-based and carrier fixed-wing aircraft, ASW helicopters, destroyers and anti-submarine submarines all working together, directed from my flagship and command post,

(Continued on page 57)

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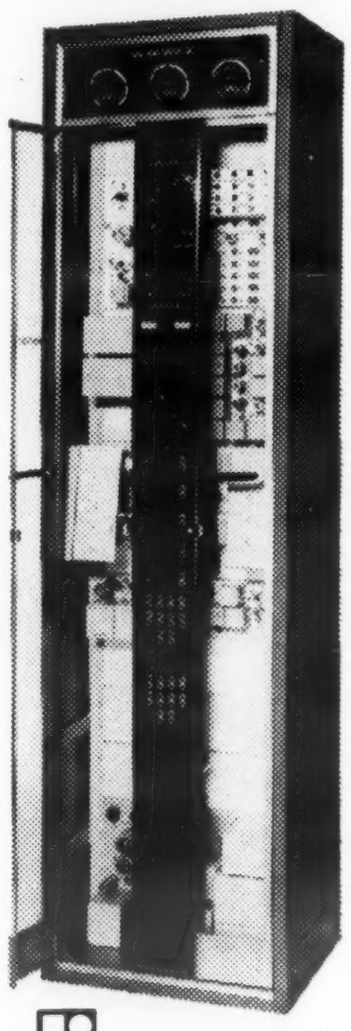

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(Continued from page 55)

the aircraft carrier *Valley Forge*. By knowing each other's strengths and weaknesses, we can work together to use each vehicle's greatest capabilities and compensate for one's limitations with another's capabilities. Our anti-submarine submarines have the longest detection ranges, but can't move very far or fast. So, we give them airplanes to go out and investigate their contacts. But the airplane's ability to hold his contact is rather limited, so we send in destroyers to work with the aircraft. Using all our strengths, we have discovered that the whole is far better than just the sum of the parts.

Task Group ALFA has made very encouraging progress in tactics and coordination, but no matter how good we get with our present equipments, eventually we will reach a plateau where we can go no further without better tools. Our detection ranges are so limited that all the task groups of the Hunter Killer Force working together can't cover the vast expanse of oceans where submarines can threaten. We could solve the problem simply by providing more and more forces, but the number required to cover the Atlantic adequately would be astronomical. Alternately, we could solve the problem by improving the performance of each vehicle and equipment. Then with the resultant increase in capability, the numbers of units required would be reduced to manageable proportions. Short of the miracle breakthrough, this will have to be the solution.

We cannot afford to wait for the great panacea of 100% improvement. We must work for step-by-step improvement now and overlook no possibilities. The better our tools become the fewer of them we will need. Right now we need a lot more, a lot better.

The cards are on the table. They call it cold war, but it is just as grim a conflict—and its outcome is just as vital as any of the bloody wars we have fought already for our national existence. It is no secret that the communists are the aggressors. They themselves have announced on many occasions their determination to rule the world by any means, fair or foul. Military might is the major lever in their political warfare, but obviously at present they do not want a shooting war anymore than we do. They prefer to gain their objectives through the threat of force and the prestige of military strength. Any intelligent enemy seeks the line of least resistance. We have seen this technique again and again—the probing for vulnerabilities with loud talk, backed by very obvious military might. We must counter with a demonstrated ability to meet the threat, if they attempt to carry it out.

The submarine can be another versatile instrument for diplomatic pressure, as yet, fortunately, not fully committed by the aggressor. Four hundred and fifty hostile submarines are trouble enough. The addition of a guided missile capability makes the troubles of Job seem like a Florida vacation. We must devise a system of effective surveillance of every ocean area from which submarines could launch a missile attack and at the same time assure the security of our vital sea lanes. If we can do this, they will never use their submarines.

Obviously we cannot pack up our whole economy and go off chasing submarines. That would be just as silly and just as dangerous as ignoring them. On the other hand, we can no longer shrug off the submarine threat. Anti-submarine warfare is clearly a national problem. We must enlist the aid of everyone who can contribute research, techniques or equipment toward beating the submarine at sea.

ASW in the Navy has top priority. From you in industry, we ask for scientific vigilance. There is not a single member of the scientific fraternity who cannot contribute to anti-submarine solutions. Our airborne Magnetic Anomaly Detector, for example, started its ASW career in an industrial attempt to locate oil off the Gulf coast. The radar principle was picked out of what was thought to be an interference in new communications equipment. We must be ready to exploit every hint or suspicion of solutions to our ASW problems. We haven't the time nor money to search indefinitely. We must be alert to deal with the thrust and parry of communism today, tomorrow, wherever it appears.

The only answer short of national bankruptcy lies in balancing our military capabilities to deal with every threat adequately, but without the waste of our insuring for any one contingency. Nothing could be more foolish than to shut, bolt, lock and nail the front door closed and leave the cellar door ajar. A deterrent is absolute. Either it deters or it doesn't. We have achieved a stalemate in strategic nuclear capabilities. We have a strong capable continental air defense. It can be rendered useless unless anti-submarine defense is equally effective. We must fashion a lock for our cellar door.

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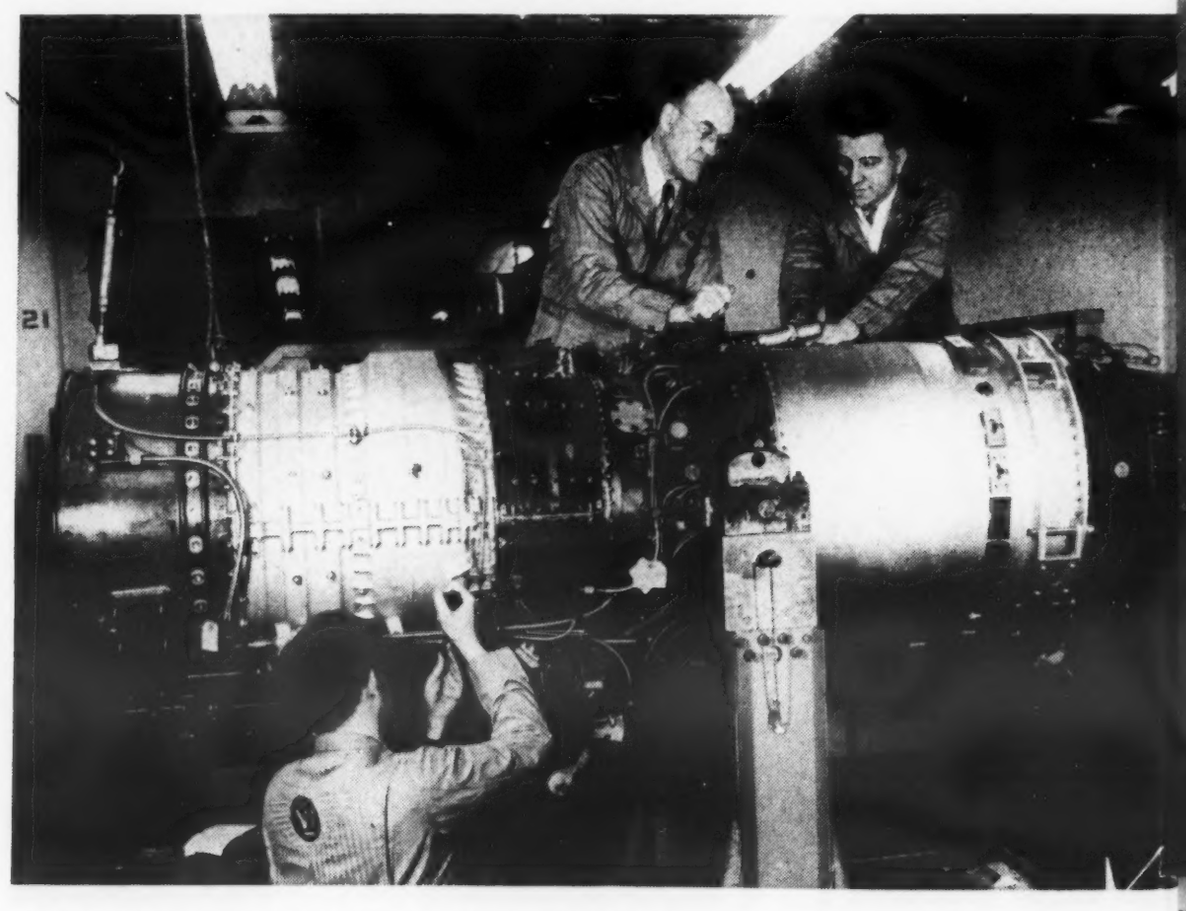
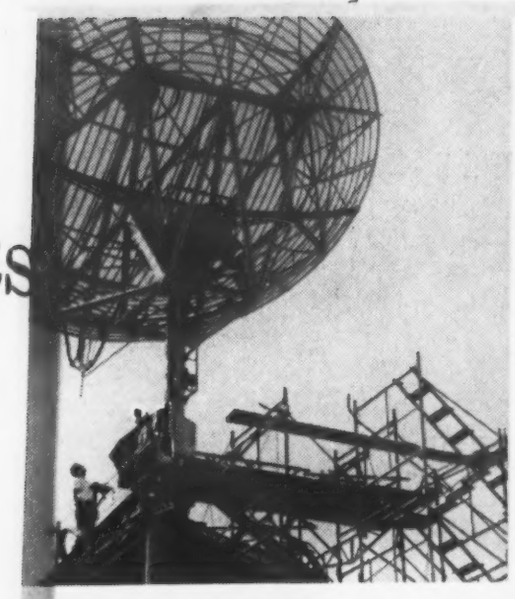
MISSILE GUIDANCE SYSTEMS. Both ground guidance and terminal guidance systems are designed, developed and produced at Westinghouse. More advanced gu systems are now being developed to replace those in production and in actual operation. The latest techniques in radar, infrared, and data processing and displ being applied to all phases of missile guidance by Westinghouse engineers with many years of experience in this field. ***Air Arm and Electronics Divisions***

AIRBORNE ELECTRONIC SYSTEMS for weapons control, terrain avoidance, bombing and navigation, antisubmarine warfare, missile guidance, bomber defense and other applications are designed and manufactured by Westinghouse. Aero 13 Armament Control System, shown above, for the Navy's F4D Douglas Skyray fleet interceptor, is a recent example. ***Air Arm Division***



PROPULSION. From the design of America's first turbojet engine in 1941—by 14 pioneering enginee Westinghouse—to present-day engines for high-speed aircraft, Westinghouse has kept pace with aviation industry's constant demand for increases in engine power and efficiency. Current applica include the use of new metals and advanced design features to attain maximum thrust-to-weight r higher speed and higher altitude performance. Jet propulsion engineering reached a new high wh recently developed Westinghouse engine met design goals just 11½ months after these goals were ***Aviation Gas Turbine Division***



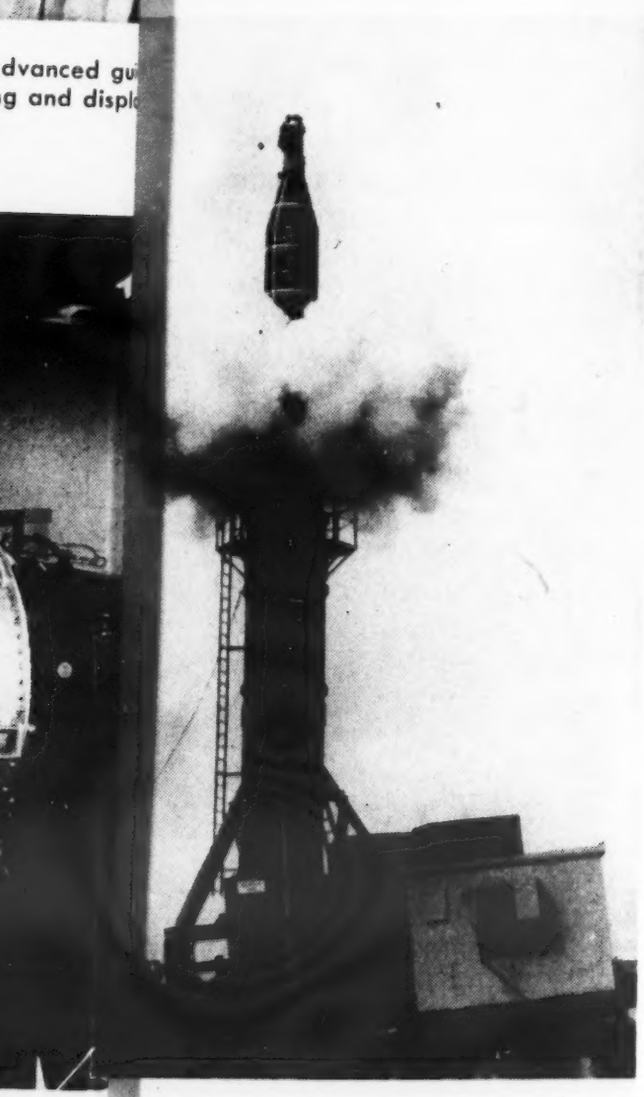
IENCED FIELD ENGINEERS are an impor- djunct to Westinghouse engineering capa- . Located at key locations abroad, in this y, and afloat—wherever Westinghouse ment is in use—these field engineers supply perience and information needed to fully new equipment, help indoctrinate new nel, and provide technical liaison with the acturing plants of the Defense Products

AIRCRAFT ELECTRICAL SYSTEMS. From Jenny to jet, Westinghouse has been producing aircraft electrical equipment representing the day's most advanced state-of-the-art. Systems for today's finest aircraft—including the Boeing 707 jetliner, Convair B-58 bomber, and North American A3J-1 twin-jet fighter—are Westinghouse designed and developed. These systems include the entire a-c power system, control and protective devices, and feature the world's first brushless generator . . . result of pioneering experience dating back to the first airborne, strut-mounted a-c generator built by Westinghouse in 1917. ***Aircraft Equipment Department***

AN ENGINEERING—mating man and the ine—is important in electronic equipment n. Continuing scientific study and research estinghouse facilitate advantageous appli- n of this concept—from missile analysis to tenance design—in developing better hic systems. ***Air Arm Division***

NUCLEAR ENGINEERING experience is still exceedingly uncommon, but Westinghouse probably has more knowledge in this very specialized area than any other company in the world. Westinghouse has designed and developed more nuclear power reactors than anyone else. Its engineers have worked in almost every field related to atomic energy. Five different commercial reactor designs are now under active development.

UNDERWATER WEAPONS SYSTEMS. Westinghouse engineers designed the Navy's first all-electric torpedo in 1942. Since then, Westinghouse engineers have continued work on new and improved underwater systems, to include high resolution sonar and a high speed, long range anti-submarine torpedo. Technologies involved include hydrodynamics, acoustic systems, servo mechanisms, and guidance control. ***Ordnance Department***



IDERWATER IRBM LAUNCHER for the sub- rine-based Polaris missile, shown here during rly test launching with dummy missile, was de- ned and built by Westinghouse. Design fea- es developed for this system appear appli- ble for use in other solid fueled missile unching systems.

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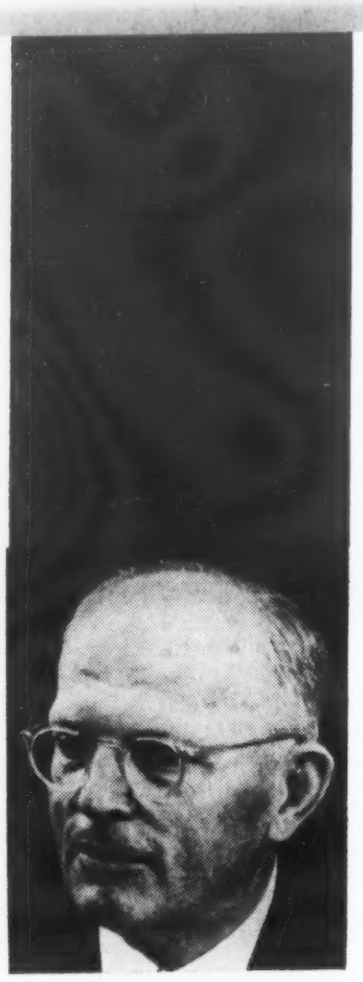


by Maj. Gen. W. Preston Corderman
President, Times Facsimile Corporation
(Division of Litton Industries, Inc.)

IN THE almost unbelievable surge of electronics technology during the past decade, few companies have attempted to keep abreast in more than two or three application areas. New uses of the versatile electron have made sudden and dramatic news as stories and articles appear daily in the press. With such feverish activity considered normal within the industry, it is no wonder that the great majority of companies have chosen a particular area of the new technology, evaluated their capabilities within that area, and specialized. Many have become very healthy companies by restricting their activities to a chosen field.

There is, and will always be, a great need for this type of specialization. But there is also another need that must be met if our industry is to continue its spectacular growth. Our industry needs, indeed our country needs, the versatile electronics company with specialized knowledge spanning many areas of electronics technology. Such a company has a greater capability for relating research and development breakthroughs to our total electronics effort. With defense agencies and industrial users making enormous demands of the new technology, the electronics industry must satisfy this demand wtih a constant flow of new products. The versatile company, capable of research, development, engineering and manufacture in many areas of electronics, is a necessity. The technological race is meaningless without end products.

Since joining Litton Industries, the phrase I have heard used most often to describe the company is "electronics-based." Very simply, this phrase means that the end products of the company's various divisions are all based on electronics technology. While these products are diverse in their final form and use, the company would not be classed as "diversified" in the usual meaning, since it has never attempted to venture beyond the sphere of electronics technology in its product group. This is a large enough sphere to provide a constant challenge.

Currently, Litton's technological and manufacturing capabilities extend into various specific areas: communications, navigation and control equipment, business machines, electron tubes, microwave equipment, radar, countermeasures and industrial and military computation and data processing equipment and systems.

Perhaps the Litton activity most familiar to the lay public is some of the work being done in the Space Research Laboratories in Beverly Hills. The company's man-in-the-space-suit has been featured in newspapers, magazines and television throughout the country. Ironically, physics research of the most advanced order is being conducted in these laboratories. A continuing study on the properties and behavior of materials, with emphasis on friction effects in a space environment, has been contracted for by the Air Force Office of Scientific Research.

Astrodynamics research, performed with the cooperation of the Air Force's Wright Air Development Center, includes the simulation of varied environments within the Litton space chamber. Temperature and radiation gradients, advanced vacuum technology, space vehicle guidance and control systems and extraterrestrial operations analysis are a few of the areas of concentration in this field of research at Litton.

In bioastrophysics research the company's scientists are studying home-instrumentation including the feasibility of using brain and muscle electrical impulses in vehicle and equipment control, crew selection criteria and closed artificial environments.

With the only inhabited high vacuum chamber in the free world available for research, Litton's work in these fields is unrivaled.

I have been amazed at the nature and scope of the work of our Space Research Laboratories, all, it seems, destined for ultimate use in some distant tomorrow. Yet Litton is a company with approximately 55 per cent of its business rooted in the industrial and commercial electronics market of today. How does a company keep its research in the vanguard of the industry, yet market successful products in a variety of highly competitive areas within this industry?

Litton executives feel that the answer lies in balanced management.

Today Litton is managed by a well-balanced team of specialists in re-

search, administration, product development and design, manufacturing, marketing and sales. No one phase of the entire operation dominates, hence the problems of one become the problems of all. Occasions arise, for instance, when engineering feels that it could do a better job on a particular piece of equipment if it were given another six months. The management team might decide, however, that the equipment is sound, competitive and abreast of the state of the art. Manufacturing, marketing and sales executives assure other members of the team that the equipment is a profitable venture in its present state of development, since there is a definite industry need at that time. Another decision is made, taking into account the feelings of the entire management group.

Planning, both short and long term, is another area in which Litton's management considers the advice of all members of the team. Lead times are arrived at much more realistically when the figure is determined after careful consideration of the problems faced by various management members. For this reason arbitrary schedules and crash programs are the exception. Both are costly, and the effect on organization is trying.

Each division or separate operating subsidiary of Litton, is run on an autonomous basis by its general manager. Since, in many cases, this general manager is also a member of corporate management, he is also a member of the corporate staff. The net effect is a much better informed "line," capable of taking into consideration the larger problems and policies of the organization.

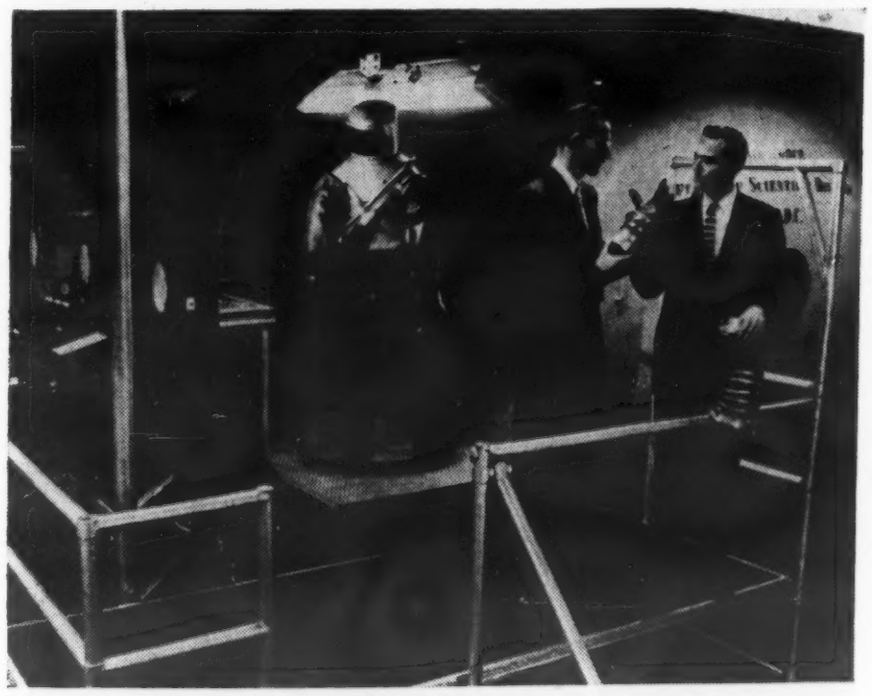
Briefly, the several divisions of Litton are: the Electronic Equipments Division where the company's inertial guidance, automatic data processing and airborne early warning systems are researched and manufactured; the Monroe Calculating Machine Division; the Maryland Division where engineering and manufacturing of a variety of communications, fire control, navigation, microwave, and missile control systems take place; the Triad Transformer Division; the Electron Tube Division, making more than one hundred types of magnetrons, klystrons and other electron tubes; The Airtron Division manufacturing a complete line of microwave relay equipment and systems; the Precision Potentiometer Division; the USECO Division making electronic hardware, and Westrex Division, a recently added manufacturing and marketing organization specializing in precision sound recording and reproduction equipment; the Times Facsimile Corporation.

These activities are located at twenty research and manufacturing sites in the United States, with a European plant in Amsterdam, Holland. Sales and service offices in 350 cities throughout our country and 50 offices overseas give Litton an up-to-date marketing organization unique in the young electronics industry.

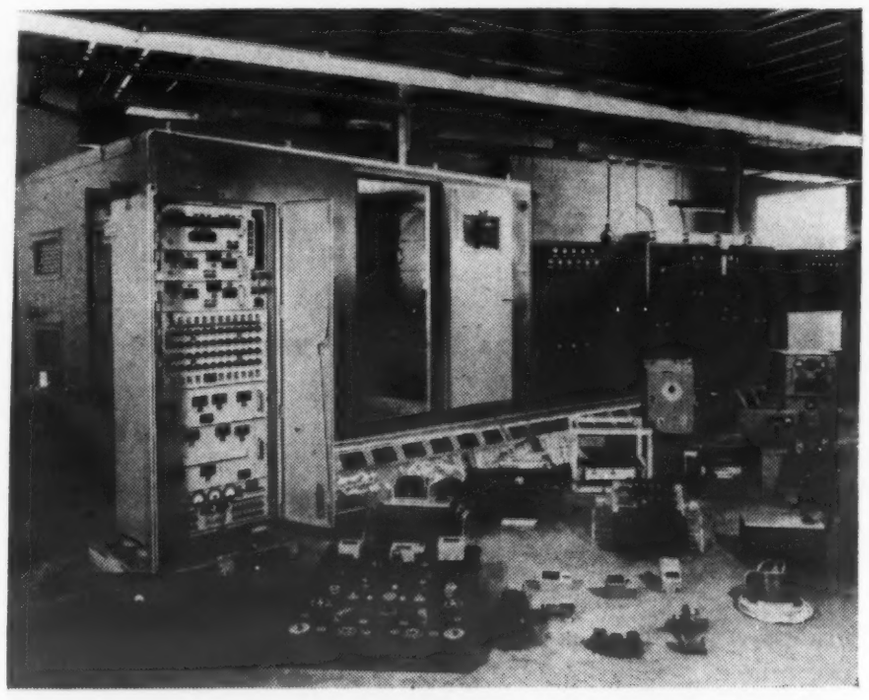
Quite apart from the technological capability implied by a company's many areas of accomplishment, there is another factor that many of us overlook when we consider its contributions to our national defense. That factor is sound financial structure, relatively independent of the sudden setbacks caused by contract cancellation in defense work. The security of such a position comes only from a healthy split between military and industrial-commercial activity. Litton sales are today nearly balanced at a 45 per cent military—55 per cent industrial-commercial level. It is management policy to try to maintain this balance.

One of the most gratifying things that I have found since coming to Litton is that the accent is on the future at all levels of operation. Each division is very much concerned with tomorrow. While it is a young company, as most companies are in this young industry, there is an unusual and satisfying hum of activity that catches one up. A walk through one of our laboratories becomes a very stimulating experience, and I know that the events of tomorrow are taking shape all around me.

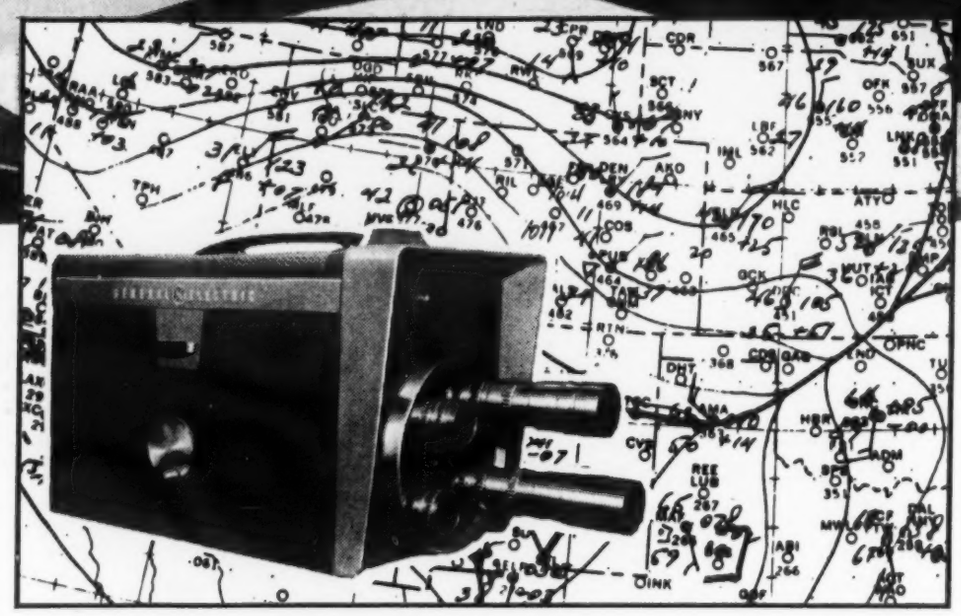
The world today is changing at a rate that even the most imaginative of men sometimes find astonishing. News headlines frequently border on fantasy. But the headlines are indeed fact, and in nearly every case electronics made the fact possible. Litton Industries is making, and I am sure it will continue to make, real and immediate contributions to the dramatic advance of electronics.



Sig Hansen, designer of Litton's space chamber and suit, explains a hand section of the suit to Dr. Henry E. Singleton, Litton Vice President and General Manager of its Electronics Equipments Division. The chamber, capable of simulating the vacuum environment found at 125 miles above the earth, is the only one in the Free World.



Some of the products manufactured in Litton Industries' Maryland Division. In the background is a mobile instrument landing system unit, delivered in quantity to the Air Force. Microwave antennas, fire control systems, communication and missile control systems are also manufactured at the Maryland Division.



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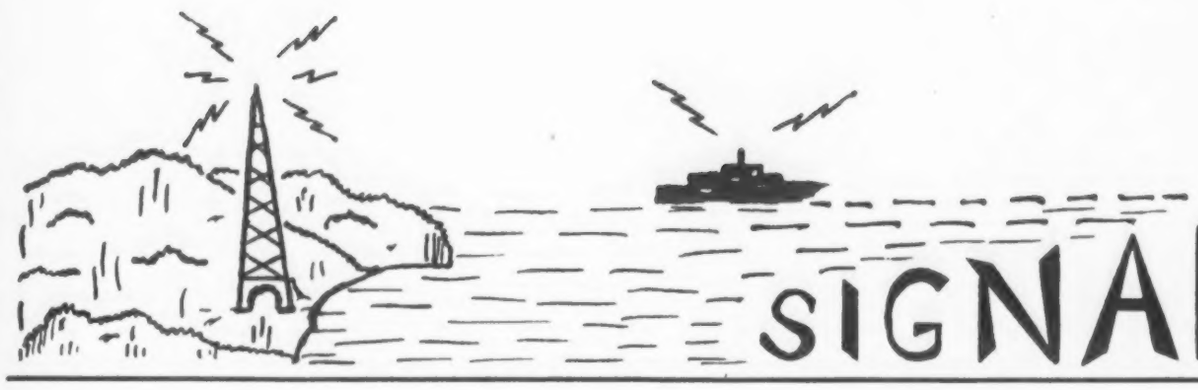

SIGNAL·GRAM

— GOVERNMENT —

AT A SENATE SPACE SUBCOMMITTEE public hearing, Roy W. Johnson, Advanced Research Projects Agency Director, indicated that it is theoretically possible that Russian radar and other communications could be disrupted temporarily by one or more high altitude atomic explosions over the Indian Ocean. A similar blackout of American radar and radio communications is theoretically possible by Russian high altitude atomic explosions. Mr. Johnson stressed his personal belief it is useless to spend millions of dollars on perfecting the MRSV program (Maneuverable Recoverable Space Vehicles) until the Government learns from its Project Mercury program whether a man can live in outer space.

NASA has awarded a five-year contract for West Coast purchases of liquid hydrogen, a high-energy rocket fuel ingredient, to Linde Co., a division of Union Carbide Corp., Torrance, Calif. The contract calls for no guaranteed purchase amount. General Electric Co. has received a $5 million NASA contract for development of a liquid propellant engine to power the second stage of the Vega space vehicle. The engine will be a modification of the Vanguard first stage engine, fueled by liquid oxygen and kerosene and will develop some 35,000 pounds of thrust.

ULTRAVIOLET PICTURES OF THE SUN Navy rocket specialists report they have succeeded in snapping ultraviolet pictures of the sun by capturing on film the kind of solar radiation that disrupts the earth's radio signals. These photographs, no larger than 1/8" square, were taken by a special camera carried to an altitude of 123 miles by an Aerobee-Hi rocket. When enlarged 35 times, the pictures gave scientists their first view of the clouds of hydrogen gas that swirl 4,000 to 6,000 miles above the surface of the sun. Such rocket astronomy may ultimately help man understand how solar radiation affects radio communication and may lead to daily reports on solar activity which, according to some scientists, affects changes in the earth's weather.

U. S. EXHIBIT IN MOSCOW Allied Radio Corp., Chicago, has accepted an invitation from the Office of American National Exhibition in Moscow, Wash. 3, D. C., to display 5 of its electronic Knight-Kits in the first all-U.S. exhibit ever to be presented to the Russian people. American private industry is participating with the U. S. government to show Russian citizens "How America lives, works, learns, produces, consumes and plays; America's cultural and spiritual values." The $3,300,000 U. S. exhibit is scheduled to open on July 4th and will continue for 6 weeks. Russia will reciprocate by holding its own exhibition in the Coliseum in New York City beginning June 28, for a period of one month. Other AFCEA Group Members reported exhibiting are: Dictaphone Corp., Zenith Radio Corp., Motorola Communications & Electronics, Inc., Westinghouse Electric International Co., Smith-Corona Marchant Inc., Eastman Kodak Co., International General Electric Co., American Machine & Foundry Co. and Philco International Corp.

CONTRACTS: ARMY: Western Electric Co., planning on the Nike-Zeus, $9,950,000 & work on Nike-Hercules missile equipment $8,900,000; Gilfillan Brothers, Inc., Corporal missile repair parts, $68,887; Telecomputing Corp., overhauling of rate gyros and amount gyros that are being used in the Nike-Ajax, $660,000; General Electric Co., further research and development of super-sensitive low-light-level image orthicon, $154,365. NAVY: Raytheon Manufacturing Co., follow-on production of the Sparrow III, $64,600,000; International Business Machines, logistic support and maintenance of the AN/FSP-7, $2,644,000; I-T-E Circuit Breaker Co., 53 shipboard radar antenna systems, approx. $1,000,000; Bendix Radio Div., Bendix Aviation Corp., VHF Communications Systems, $350,000. AIR FORCE: Avco Mfg. Corp., Crosley Div., fire control systems for the B-52 bomber, $3,120,000; Aeronutronic Systems, Inc., development and testing of decoys in support of the intercontinental ballistic missile program, $2,327,000; Lear, Inc., automatic flight control components for the KC-135, $1,500,000; Motorola, Inc., production of 168 radar guidance beacons and command data links for Bomarc, $3,817,183.

A 15,000-MILE WESTERN UNION private wire system has been inaugurated at General Dynamics Corporation. Providing instantaneous two-way communications between 62 plants and offices across the continent, the network has a capacity of more than 170,000 words an hour, or roughly the traffic handled by a small city. Three message centers in N. Y., San Diego and Ft. Worth are connected directly with Western Union's national and international public message network, enabling all General Dynamics' offices to transmit telegrams conveniently to other companies.

CONSTRUCTION of a $1.5 million Los Angeles plant, doubling its semiconductor production capacity, has been announced by Hoffman Electronics Corporation. On completion, scheduled for Sept. 1, the 109,000 square-foot facility will serve as administrative headquarters for the Semiconductor Division, now in Evanston, Ill., and for producing solar energy conversion devices. The Evanston plant will continue its solar cell production.

THE DEPARTMENT OF DEFENSE RESERVE AWARD CERTIFICATE AND PENNANT have been presented to Automatic Electric Company at Northlake, Ill. The company was cited by the Department of Defense for "outstanding cooperation with the Armed Forces Reserve Program" through programs designed to encourage employee participation in reserve activities.

GENERAL ELECTRIC COMPANY, Lynchburg, Va., has combined its Technical Products Dept. of Syracuse, N. Y., and its Communication Products Dept. of Lynchburg, Va., into a single communications organization to be known as the Communication Products Dept. The Technical Products Dept. manufactures and markets broadcast equipment for the radio and television industry plus closed circuit television; recently, this department announced a new monthly lease plan permitting television studios to rent the most modern equipment available over a five-year period. Communication Products produces and sells two-way mobile radio, microwave communication equipment and power line carrier equipment.

MILAN, ITALY Philco Corp., Philadelphia, has purchased a factory in this area and will begin production of television sets, refrigerators and washing machines. Philco products have been manufactured in Milan previously, but this will be Philco's first effort to produce directly in the Italian market. It is believed that initially, parts will be imported and assembled in Milan and eventually there will be a complete production unit in Milan.

GENERAL TELEPHONE AND ELECTRONICS CORP. has purchased controlling interest in the York, Pa., Telephone & Telegraph Co. The York company serves about 70,000 stations in the south central part of Pennsylvania. Under Pennsylvania law, according to Public Utility Commission officials, approval of the transaction will not be required because the purchaser is a holding company and not a utility.

SOUTHERN BELL TELEPHONE & TELEGRAPH CO. has received the Certificate of Recognition from the Air Defense Command. This high award was presented to Southern Bell President Ben S. Gilmer on behalf of the company's 70,000 employees for their voluntary services "in support of their air defense of the United States," and for contributing to the Ground Observer Corps program.

MALDEN, MASS. The National Co., Inc., has acquired all outstanding stock of Mutual Electronic Industries Corp. Mutual fabricates Edge-Lit panels, connectors and holds patent rights for elastic cable and wiring. Mutual will be operated as a wholly-owned subsidiary of National. National will add to the present product line of Mutual.

FOR THE FIRST TIME the American people and company stockholders heard an annual meeting of stockholders, when American Machine & Foundry Company broadcasted highlights of its meeting over the NBC Radio Network on April 21st. Morehead Patterson, AMF Board Chairman, said, "We believe that this program will help contribute to a greater understanding of American business and encourage more active participation by everyone in corporate ownership."

NEWS FROM COLUMBIA BROADCASTING SYSTEM, INC. reveals that the company's CBS-Hytron Division, manufacturer of tubes, transistors and other electronic components, is planning a $5 million expansion of its semiconductor operations. Included in the expansion plans is a 160,000-square foot semiconductor plant to be built in Lowell, Massachusetts; production at this facility will be concentrated on the manufacture of industrial and military transistors and crystal diodes. Effective July 1, the company is changing its name to CBS Electronics.

(Continued on page 66)

DR. HARVEY E. WHITE teaches Atomic Age Physics to 270,000 students on NBC's 5-day-a-week "Continental Classroom."

RCA Electronics helps put new life into learning

Five years from now America's student population will approach 50 million—8 million above today's figure. By present standards there may be too few teachers and classrooms. But an important part of this problem will be solved *through electronics.*

Already, teachers are increasing student interest and covering ground faster with the help of such electronic aids as: RCA radios, records and record players, special audio-visual aids, TV, and tape recorders included in the "Language Laboratory Package." More than 200 colleges and secondary schools have installed closed-circuit TV to improve instructing techniques and spread top talent beyond the walls of a single classroom. Still other schools use the programs of America's 35 licensed educational TV stations—approximately 60% of which are RCA-equipped. Even at home, adults and youngsters alike are earning school credits through television.

Helping the teachers reach millions of students, providing communities with better schooling at the least cost are just a few of the ways RCA helps strengthen America—through electronics.

RADIO CORPORATION OF AMERICA

Signalgram *(Continued from page 64)*

— GENERAL —

A GIANT COLOR PHOTOGRAPH has been installed in the Cincinnati Music Hall. Said to b the world's largest color photograph, this 80 feet long and 20 feet high photograph is a scene of Diamond Head in Hawaii. Made at the Tampa, Fla., plant of Color Corp. of America, this "ultra-mural" is framed in a manner creating the illusion of a huge picture window.

AN ELECTRON TUBE INFORMATION COUNCIL has been formed by 8 receiving tube manufacturers: CBS-Hytron, General Electric Co., Philco Corp., RCA, Raytheon Manufacturing Co., Sylvania Electric Products Inc., Tung-Sol Electric Inc. and Westinghouse Electric Corp. Their objectives are: "To promote the use of tubes in these electronic applications where they offer superior properties; to emphasize the engineering factors involved in the selection of alternative electron valve-type devices; to focus attention on new trends and developments in tube technology." The council is open to all tube manufacturers.

AUTOMATIC ELECTRIC COMPANY has been selected to provide a vital communications system for the government's new missile testing center at Vandenberg Air Force Base, Calif. The contract calls for installation of a 3500-line, 4000 terminal-per station P-A-B-X telephone network. Installation is to begin shortly.

AUTOMATED BOWLING BEGINS IN EUROPE The first machines on the continent of Europe automatically setting the pins and returning the ball in the game of tenpin bowling are now operating at the Lindsey Air Station, Wiesbaden, Germany. The Automatic Pinspotters were manufactured by American Machine & Foundry Company.

A SPACE MUSEUM for Huntsville, Ala., is being planned. Some 25 firms working in missile programs have been asked to provide exhibits for the museum. A part of Redstone Arsenal may be given as a site for the museum. Displays of earth satellites and biographical material on the Army's missile scientists are planned.

A PROGRAM to provide transitional training for retired officers of the Armed Forces who want to prepare themselves for positions in industry has been established by the Management Institute of Temple University in Philadelphia. This program, announced by First Army Headquarters, Governors Island, N. Y., fulfills a long-standing need for this type of training. The training schedule calls for ten days "on campus" instruction and consultation.

A NEW EDITION of its illustrated handbook on how to tell the tornadoes from the other clouds has just been published by the Weather Bureau, U. S. Department of Commerce. It is used by tornado network observers, among whom are many thousands of volunteers. The pamphlet is called "It Looks Like a Tornado," and is a dime at the Government Printing Office, Washington 25, D. C.

AT A MEDICAL ELECTRONICS SESSION at the IRE National Convention, Dr. Vladimir K. Zworykin of the Rockefeller Institute for Medical Research and the RCA Laboratories, reviewed some of the important advances resulting from improved communications between medical men and engineers, such as the applications of electronic data processing techniques to medical diagnosis. To further the medical electronics market, he said that some means must be found of absorbing the resulting high cost of equipment and the establishment of independent facilities for engineering and testing medical electronics equipment, which would relieve instrument manufacturers of some of the existing economic risks and delays.

CALENDAR OF EVENTS:

MAY 21-27: The International Convention and Exhibition on Transistors and Associated Semiconductor Devices will take place at Earls Court, London, England. The event is sponsored by the Electronics and Communications Section of the IEE. Approximately 200 technical papers will be presented and some 2000 delegates are expected to attend the Convention. Send all applications for Exhibition tickets to: Industrial & Trade Fairs Ltd., Drury House, Russell Street, London, WC2, England.

MAY 25-28: The Design Engineering Show is to be held at Convention Hall in Philadelphia, Pa., and is sponsored by the Machine Design Division of the American Society of Mechanical Engineers. Approximately 400 exhibits to be on display. Request advance registration cards and information from: Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y.

JUNE 3-5: 13th Annual Armed Forces Communications and Electronics Association Convention will be held at the Sheraton-Park Hotel, Washington, D. C. Don't miss it!

Sentry that spans a continent

The pre-eminence of Radio Engineering Laboratories, Inc., in specialized radio communications is again underscored by the selection of its equipment for the gigantic tropospheric scatter network being constructed by NATO.

This network, with more than a continental span, will stretch from Norway to Turkey. It is larger by far than any other tropo communications complex yet conceived. REL has designed and is constructing one hundred fifty-three transmitter modulators, one hundred nine 10-kilowatt amplifiers, and seventy-seven quadruple diversity receivers with combiners.

With millions of lives at stake, only supremely reliable equipment could be considered. REL, which has developed and manufactured more tropo scatter radio apparatus than all other companies combined, was awarded the contract after international competitive bidding in accordance with NATO infra-structure procedure.

The imagination and facilities which have won REL world leadership in military and civil tropo scatter can help solve *your* specialized radio problems.

REL

Radio Engineering Laboratories·Inc

A subsidiary of Dynamics Corporation of America

Dept. G· 29-01 Borden Ave · Long Island City 1, NY

the advance in space power for peace

by Lambert L. Lind, Jr.
Special Assistant to the Director,
Advanced Research Projects Agency

ONE OF THE hallmarks of our time is the great extent to which political and social phenomena have come to be expressed in terms of space programs. Space preparedness has become a question of developing advanced space vehicle systems at costs that can be accepted within our national economic framework. This advance in the space effort has become a matter of coping with the amazing speed at which events and discoveries do occur.

A significant fact of the Space Age is that we do not have lengthy periods of time for readjustment or for change, and this leads to our actions being predicated more upon the future than upon the present.

A responsible approach to this new problem must involve an important change in the thought pattern of the American people. In order to perpetuate our democratic way of life, we are becoming as dependent on events which will take place five to ten and more years from now as upon events which are taking place now.

We have had an inconsistent past. Support for research and development, as for all types of defense expenditure, has throughout our history accelerated and decelerated according to the popular assessment of the threats to our way of life. This short range approach to national problems can no longer be tolerated. It is adequate neither for the maintenance of a healthy economy nor for the achievement of our national security.

When space breakthroughs can alter the traditional balance of international power in a matter of days, our only posture cane be to attempt to achieve these breakthroughs first. Moreover, since space systems are costly, frugality and wisdom dictate that these systems be developed on a continuing basis under a long range program. Constant stops and starts will yield little but frustration and extravagant waste.

The House of Representatives Committee on Science and Astronautics has stated that it would be highly impractical not to face the reality that space technology, like nuclear technology, can be used for war as well as for peace. It has noted that the United States must continue to strive for conditions that will make it possible for all space research to benefit mankind, but that this effort is meaningless unless it is accompanied by an American and Free World effort to develop space devices of the highest order of versatility. The Committee emphasizes that failure to do so would deny the Free World not only the peaceful benefits of space, but also the capability to detect hostile moves against its member nations, including violation of agreements, and would deny the further ability of the Free Nations to counter such threats. Further, the Committee recognizes that while an armaments race does not guarantee peace, development of powerful new weapons capabilities by a single nation, might possibly, under successful security blackout—an Iron Curtain, if you please — pose a great threat to the Free World, and, to the people in the threatened countries.

We in ARPA recognize that space is not a scientific discovery; it does not choose those who use it. Space is a place. This place, much larger and more unknown than any we have encountered, can be used for whatever the imagination of the scientist, soldier, politician, economist, and business leader can devise. Space can be used for communications, for navigation, for early warning, for weather forecasting, for manned space flight, for transportation, for scientific exploration and for commercial enterprise.

The Department of Defense is cognizant of this situation, and through the Advanced Research Projects Agency, is conducting an expedited program in the field of military space technology. It is important that the members of AFCEA, who have so much to do with the technological and business health of this nation, be aware of the advances that are being made in space technology. We have built these space projects upon the vast range of space-related defense research which has been accomplished over the many years since World War II. To a very significant extent, our whole present U. S. space effort is related and indebted to prior missile and other defense research and development. The space program has not only inherited a wealth of knowledge and experience from previous defense research, but, in addition, a tremendous capital investment of billions of dollars. Thus, our space achievements of today and for the next year or so are based not only on accumulated experimentation, but upon substantial outlays, all by-products of very expensive missile predecessors.

The inheritance is a lucrative one for the nation, but we must recognize that now, as we advance toward operational manned and unmanned space equipment, the costs chargeable directly to space programs are bound to become "visible." These costs are not only the price of progress, but the price of national existence. They are involved in the development of propulsion devices, electronic mechanisms, and space vehicle configurations going far beyond the present state of the art and beyond our present power requirements for peace.

In 1958, using the Redstone, Thor, Jupiter and Atlas military missiles as basic boosters, the United States successfully launched several important Explorer satellites. For the next couple of years, due to the long development time involved in the creation of totally new vehicles, the United States Space Program will be based largely on the use of Thor, Jupiter, Atlas, and Titan basic boosters. Whereas the Thor or Jupiter boosters, which have about 150,000 pounds of thrust, can launch upwards of 2,000 pounds of useful payload into low satellite orbits, the Atlas or Titan boosters can launch upwards to 4,000 pounds.

Thor or Jupiter boosters, with appropriate upper stages, will be able to conduct deep space probes to the Moon and beyond to the near planets of Venus and Mars. They will be further capable of doing exploratory satellite research and of developing systems for the recovery of satellites from orbit.

The Atlas or Titan booster, with appropriate upper stages, in consideration

of its 4,000 pound satellite launch capability, will be adequate for our initial Man-in-Space Programs as well as for the conduct of sophisticated space operations for early warning, communications and navigation.

However, a 4,000 pound capability will soon be insufficient for the over-all space purposes of the United States. Therefore, to further our capability for putting greater weight in space, utilizing an Atlas-type vehicle as first stage, ARPA has initiated a program for development of a high energy, liquid fuel upper stage to achieve useful satellite payloads weighing up to five tons. This capability will allow us to orbit satellite payloads of 10,000 pounds at 300 miles altitude. It will allow us to place a man in a satellite orbit for recovery after several days of flight. It will further give us the means to orbit satellites of 2,500 pounds at 22,000 miles altitude. At this height, in an equatorial orbit, a satellite will revolve about the Earth every 24 hours but in sequence with the earth's rotation and will, therefore, appear to be stationary. This new propulsion system will also make it possible to land 1,000 pounds of instruments on the moon intact or to land several hundred pounds of instruments on Venus or Mars intact.

Within the next three or four years, we are going to find that we have progressed to the point where the Atlas or Titan is insufficient as the basic booster because we shall be able to plan seriously for manned space platforms and interplanetary flight on the basis of experiments previously conducted. So that we will not be frustrated by the lack of advanced propulsion systems when this time comes, the Advanced Research Projects Agency has ordered the clustering of existing Atlas-type engines by the Army to provide a basic booster of one and one-half million pounds of thrust. We hope to have this booster available for flight test in 1960. A booster of such capacity, with an Atlas second stage and a high energy third stage, could place a 25,000-pound manned space station into orbit or could launch a manned vehicle to circumnavigate the moon and return.

Power for Interplanetary Flight

There is also under research and development by the NASA, a million-pound-thrust, single-chambered engine which should be available to the United States for space purposes some time during the next five to eight years. Clustering of engines of such immense propulsive power will provide the means for powering interplanetary manned space flight to Mars or Venus and other planets by way of space platforms.

Of course, we recognize that propulsion is not our only problem. We must learn how to guide and control a manned space vehicle so that we can, with reasonable safety, propel it on a two-way trip to regions millions of miles from the launch point. This involves development of considerable empirical knowledge we do not now have.

As a beginning, we must learn how to return a satellite from orbit. ARPA's Discoverer Program, under which we will soon begin space vehicle launches from the Pacific Missile Range, has as a primary purpose the recovery of a satellite from orbit, within an over-all purpose of developing a number of systems and techniques to be employed in the operation of space vehicles. The initial launching primarily will be to test the vehicle itself, especially its propulsion and guidance. Later, the satellite will contain bio-medical specimens to seek data on environmental conditions. This data will be useful to our national Man-in-Space Program. As part of Project Discoverer, mice and at least one small primate will be carried aloft and their recovery attempted.

The first Discoverer vehicle is a two-stage rocket. The main stage is a modified Thor and the second stage is a new rocket called the Bell-Hustler. This vehicle will launch satellites weighing approximately 1300 pounds, including the weight of the second stage vehicle, which will orbit as an integral part of the satellite. This program of ARPA's is open-ended. By this I mean that we may eventually introduce an Atlas booster with the intention of developing techniques applicable to operational space vehicles.

Pilot Maneuvered Space Ship

To our way of thinking in ARPA, there is another step in sophistication which we are going to have to take during the next 10 years if we are to be successful in ensuring the development of space power for peace. This involves the development of space vehicles which are not bound to an orbit or to a pre-set trajectory, say to the moon and back, but rather can be maneuvered by a pilot in space. The Department of the Air Force is already doing pioneering work in the field of developing maneuverable space vehicles. You are undoubtedly aware of the Air Force X-15 Program under which an X-15 aero-space craft will climb to a height of approximately 100 miles at about 3600 miles per hour and then return to earth. The X-15 includes provisions for pilot control so the human occupant will partially drive rather than merely ride the vehicle. The more advanced program, the Dyna-Soar, involves a rocket-boosted hypersonic glider which can eventually lead to a capability for maneuvering in and out of orbit under piloted control.

When we can marry our concepts of recovery and maneuver into a space vehicle having a propulsive power of over a million pounds of thrust, we shall then be capable of not only interplanetary travel, but adequate defense of the Free World. Naturally, we must not be late in development of this capability.

In addition to pursuing programs which will lead to the development of maneuverable space vehicles and manned space platforms, the Department of Defense is well under way with programs which can be described as being more related to our earth environment. In this regard, ARPA has initiated programs in the fields of communications satellites, navigation satellites, early warning satellites and cloud cover satellites. These are the primary defense applications, in addition to manned flight, which are of special interest today because they can bring real benefits to our defense posture. By making use of our new found capabilities for orbiting objects in space, we can alleviate, if not solve, a number of military problems.

One of the most interesting of these concerns the use of satellites as communications relay stations. Since, through sufficiently high-flying satellites containing radio relay equipment, broadcasts can be made from a single point to half the earth, we can obviously help the military with all of its communications problem; for logistics; for military control of equipment, men, aircraft, and eventually space craft.

Our communications satellite program will provide vitally needed expansion of intercontinental trunking capacity. Successful military operations require rapid, accurate and secure communications. This is particularly true when the information transmitted involves a national emergency. Steadily mounting demands for intercontinental electrical communications are saturating existing networks and new channels and communications techniques must be developed. Satellites offer the most promising answer.

As you know, the Score Project, directed by ARPA, gave the United States its first opportunity to use a satellite for communications relay. This is but the beginning of a program eventually leading to the stationing of a communications satellite in a 24-hour orbit, 22,000 miles above the earth.

You will recall that when I discussed propulsion, I noted that our Atlas, with a high-energy upper stage, will give us the capability to place a 2,500 pound satellite into a stationary orbit. With three or four such stationary satellites, we can accomplish point-to-point communications all around the world for such vital applications as positive control of varied defense forces, including space craft, bombers, and submarines.

Our defense interests also dictate that we develop navigational systems employing satellites. Because vast areas of the world are inadequately plotted, a more accurate space-based navigational system would be helpful to our world-wide military movements and operations of many types.

In using satellites for navigation, we are really taking advantage of the satellites' similarity to the stars, which have for a long time been important to navigational systems. The important difference, however, is that a satellite can be fitted out with a radio source which can be heard and detected by any airplane, ship, or other object on the sur-

(Continued on page 71)

MOMENT IN HISTORY

THIS IS THE "FIRST FLIGHT" of the new Air Force TITAN, America's most powerful weapon and our No. 1 challenger in the big-missile field. Time: 2/6/59—4:22 p.m. EST. The most important thing about this moment in history is not visible here—and it is this: Three years to the day from the breaking of ground at Martin-Denver, TITAN No. 1 roared into the sky. Those 36 months saw the creation of the free world's most advanced ballistic missile facility—and the development, production, testing, delivery and launching of the first of an entirely new *generation of ballistic missile weapon systems, forerunner of the Global Ballistic Missile. TITAN is the result of an advanced engineering concept—developed by Martin under the direction of the Air Force's Ballistic Missile Division of the Air Research and Development Command—which provides the most extensive pre-flight testing of components, subassemblies and full scale missiles ever undertaken. This method in the TITAN development, and in the generations of space systems to follow, may well be one of the most important single factors in speeding America's bid for space supremacy.*

(Continued from page 69)

face of the earth at any time of day or night and in good or bad weather. We would hope to have initial systems in operation within the next two years or so.

With the decrease in warning time brought about by the intercontinental ballistic missile, the Advanced Research Projects Agency is devoting attention to development of an early warning system, based on use of satellites, under Project Midas. Through this project, we will develop greater insurance against surprise attack during the missile age, in ways impossible under our present early warning system.

It is also of vital importance to the United States defense posture that the Department of Defense has the very best weather picture of areas in which it may be required to support national decisions. Reliable weather information, especially cloud cover and surface wind conditions, is urgently needed. The satellite, by virtue of its ability to transmit rapidly over a large portion of the earth's surface, provides a potential answer to present difficulties resulting from lack of weather information. Also, I think you can well imagine that by getting out above the earth hundreds or thousands of miles and looking back at the earth, entire cloud patterns can be seen, and, therefore, an excellent idea may be gained of what the weather will be in particular areas. Furthermore, by the aid of weather satellites, we can look back at the earth from above and see weather patterns over all parts of the world and not just over our own part. Naturally, such satellites have important application to scientific and commercial as well as defense interests.

All of these satellite programs can be pursued with hardware either now available or under development. Therefore, we do recognize the defense urgency of getting into space, and we are taking expedited actions based upon this recognition.

In these programs, there is not only national security at stake, but also amazing progress for the American people and all mankind. Our progress over the past decade or so has been fantastic. The ages are literally whizzing by. We had hardly become aware of the Atomic Age when it was brushed aside by an on-rushing Space Era. We are, it seems, in the early years of another renaissance. In creating and encouraging this renaissance, we are integrating the talents of government, science, industry, education, religion and law into an endeavor so potentially magnificent it can only be up-staged by the goal it strives to attain—a goal that involves not only the attainment of a just and lasting peace here on earth, but, in a deeper sense, the peaceful extension of man's dominion into the Universe.

Martin-Denver
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seven divisions
of The Martin Company

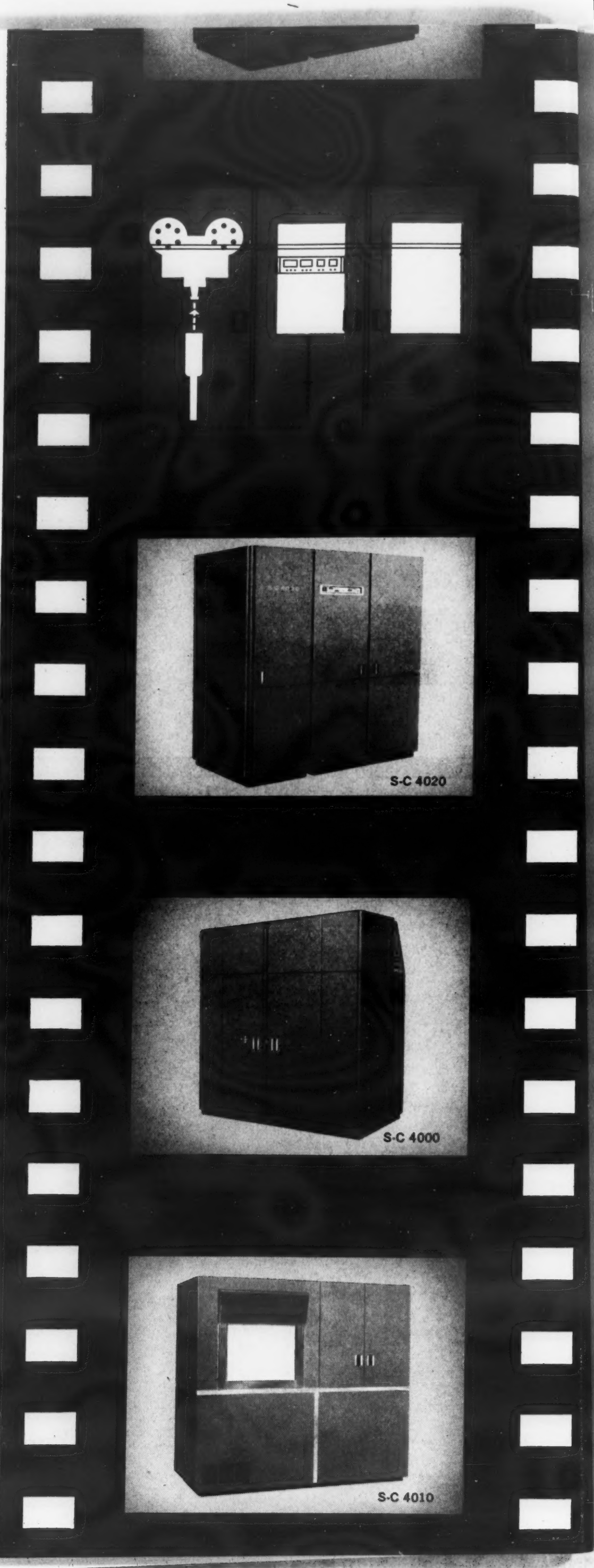
MARTIN
BALTIMORE·DENVER·ORLANDO

S-C 4020 HIGH-SPEED MICROFILM PRINTERS

Capable of printing characters and plotting points at the rate of 15,000 per second, the S-C 4020 is equally adaptable to commercial and scientific applications where high-speed microfilming is required. This versatile new printer is compatible with most high-speed data processing systems used throughout business, government and industry . . . and is capable of both on-line and off-line operation. The S-C 4020 has resulted from experience gained by Stromberg-Carlson in the development, manufacture and field testing of other microfilm printers in the S-C 4000 Series, including the S-C 4000, custom-developed for use with the Livermore Automatic Research Computer (LARC), and the S-C 4010, now used in conjunction with the Naval Ordnance Research Calculator (NORC).

Send for complete information concerning the S-C 4020 High-Speed Microfilm Printer. Ask for Bulletin 5-G. Write today: Stromberg-Carlson - San Diego, 1895 Hancock Street, San Diego 12, California.

GENERAL DYNAMICS
STROMBERG-CARLSON DIVISION



PHOTOGRAPHY REDISCOVERED

RAIFE G. TARKINGTON

Research Laboratories, Eastman Kodak Company

PART I

AS SO OFTEN has been the case with other discoveries and inventions, photography* was not explainable in scientific terms when the daguerreotype process was announced to the French Academy of Sciences in 1839. As is also the case, this lack of a scientific explanation did not delay its applications to the many fields of human activity that were its destiny.

Initially simply the best method for making pictures, its applications in other areas have extended so far that D. A. Spencer,[1] in the introduction to "Progress in Photography, 1940-1950," predicts that our descendants, in reviewing the past 100 years, will point to this era as the period in which the use of photography as a tool eventually overtook its use as a medium of entertainment. He notes further, "Who would have suspected that . . . today, with the photographic industry approximately three times the size it was in 1939, two-thirds of all the photographic materials manufactured are used in business, industry, government and science?"

The electronic industry also underwent rapid growth as an entertainment medium in this century while at the same time its use as a communication tool became well-known. Photography as well as electronics can be classified under the broad heading of "communications," and in this context both photography and electronics are now more useful to man, at least with respect to the extent of application, as tools than as entertainment media.

It is indeed fortunate that these two technologies have developed to their present position, because man stands on the threshold of space, and, as Lloyd Mallan[2] recently stated, "You simply cannot analyze any of the forces that exist in the universe without recording them (photographically) or in terms of electronics. When you can't use one, the other works for you. Quite often they work together as a perfect technological team.

"Our entire concept of the universe is based upon two techniques: first, the photographic recording of stars and the galaxies that contain them, and second, the analysis of emanations of stars, galaxies and gas clouds in distant space. So again, electronics and photography are absolutely the only tools we have on earth right now that can define the nature of the universe to us.

"Space, mankind's last great frontier, is basically dependent upon electronics and photographic methods to determine whether or not it will be conquered. It is imperative that universal forces be defined accurately if we are ever to send crews of men out into the black void—and bring them back alive."

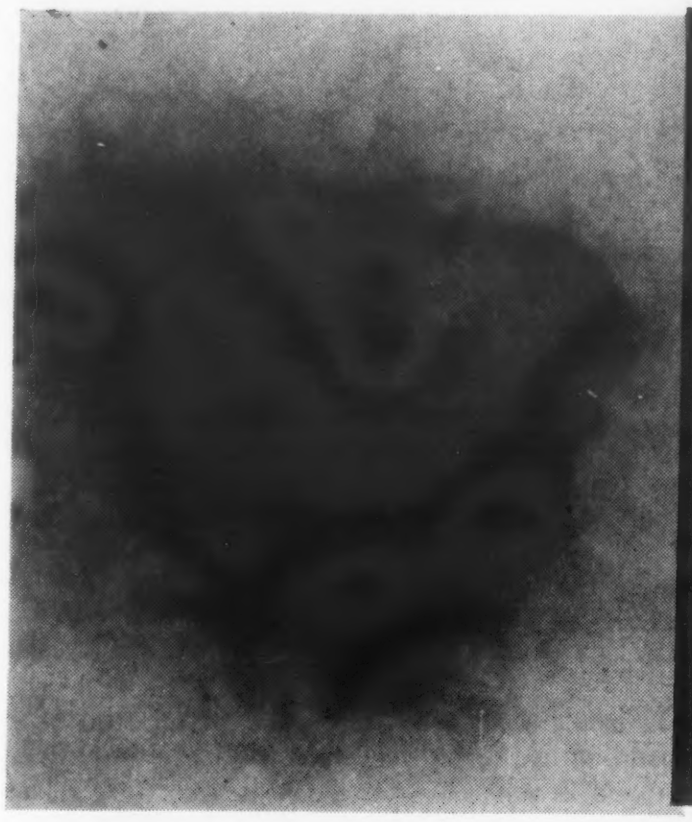
In 1839, very few people cared about the scientific principles which explained the great sensitivity and image-quality characteristics of the compounds of silver—it was sufficient that they could obtain pictures quicker and more economically by this method than by hand painting. However, the application of the photographic process to utilitarian fields is hampered by a lack of understanding of both the scientific and technological principles which make it unique as a recorder of radiant energy. Its technology has proceeded apace since 1839, but its scientific principles have only comparatively recently been elucidated.

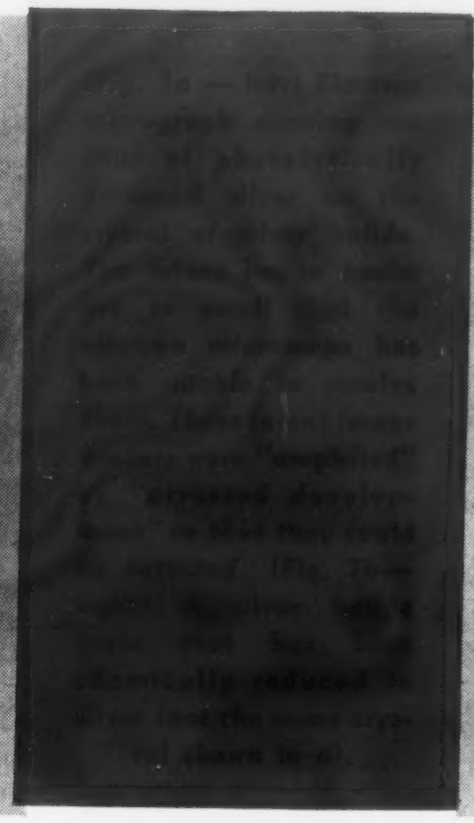
In the last decade of the nineteenth century, when many physicists were intent only on extending the decimal accuracy of their measurements, the whole science of physics underwent a revolution with the discovery of radioactivity. This and discoveries in other scientific fields provided a stimulus that resulted in almost explosive advances in science and technology in the twentieth century.

Photographic scientists have contributed to, and have profited from, these twentieth-century gains in science. Thus, by their own efforts and those of colleagues in the academic disciplines, they have been able to provide the scientific principles upon which photosensitive systems rest and have established the seemingly unique principles of the photosensitivity of the silver halides as embodied in modern photographic materials. The ability of photographic materials to discriminate between varying intensities of radiant energy is explained best by the principles of solid-state physics and development. A chemical process which accounts for its immense sensitivity can best be compared to, or described in terms of, electronic amplifiers. This latter relation is doubly fortunate since many applications of photography in the aircraft and missile fields are associated with electronic instrumentation, so that an understanding of the photographic process in "communication" terms will permit more readily its application to those recording and communication functions where its performance can be without peer.

When the first daguerreotypes were shown in 1839, the public reaction was one of amazement. If, by some chance, photography had not been discovered until recently, the public, no less than in 1839, would still be amazed. Scientists undoubtedly would share the public's interest in a simple method of making pictures, but would also be intrigued by the unique combination of scientific principles which explain the process. Therefore, to emphasize the scientific principles and to provide a new perspective of photography for those whose interest in the process is utilitarian, let us assume it was only recently discovered. Then, using our current knowledge, let us write a paper to explain the scientific and technological principles upon which the process rests and to list some of its characteristics, particularly for its use as a "communication" tool.

*For simplicity, "photography"-rooted words in this paper will be restricted in meaning to photosensitive processes based on the halides of silver.





ROCHESTER SAVINGS BANK
GOIN' CAMPIN' GEORGE ?
NOPE. JUST GOIN' OUT TO TAKE A SNAP-SHOT !
ITS TOO BAD HE WASTES SO MUCH TIME - HE'D MAKE A FINE BANK CLERK!
HE CARRIES EVERYTHING BUT THE KITCHEN STOVE !
NITRATE OF SILVER
DARK ROOM
CORROSIVE SOLUTIONS

(Fig. 2—left) Cartoon showing a "photographic engineer" using an early process. Note the "amplifier" he is carrying. (Fig. 3—right) Fifty feet by five inches of period film and the quantity of solutions required to "amplify" the data recorded.

Photography Rediscovered

(cont.)

(Fig. 4—above) Picture made by moonlight, 1/10 second, f/1.3. (Fig. 5—right) Kodak Minicard. Where necessary digital information is at a minimum, the card will store twelve 8½- by 14-inch documents.

PART II

A New Process for

Communications Applications — Photography

A new, light-sensitive process which employs a simple chemical method of amplification is now available for recording and storing data. The process consists in exposing a sensitized layer to suitably modulated radiant energy (known as an "image"); followed by bathing in several solutions successively which perform the function of amplifying the image (called "development"); dissolving the unwanted and still sensitive elements (called "fixing"); washing out the bath salts, and drying the wet material. The sensitive layer, in simple terms, is made by precipitating and dispersing one or more of the halides of silver in a suitable colloid, the best of which seems to be gelatin. Following additional operations to improve its several characteristics, it is coated on a support material to provide the desirable physical properties, after which it is ready for use.[3]

Sensitivity, that is the evidence of a detectable change after exposure to radiant energy, is a phenomenon of many materials in nature. In fact, it appears that there are many more substances affected in some way by radiant energy than those which are not—for instance, human skin is rather "sensitive." However, of this large number in existence, only a few have proved to have utility for the purpose of recording images or data. Since time in most human endeavor is important for one reason or another, the outstanding characteristic desirable in a sensitive material is that it possess high sensitivity so that the time required to obtain a record is reduced to the point where it is of little, if any, consequence in the intended application. At the same time, it should be emphasized that the quality of the image produced is a necessary implication of the sensitivity characteristic, since to have utility, the image produced must be interpretable by mental processes, or by mechanisms, in some manner related to the subject which has been recorded.

Photography possesses both sensitivity and excellent image characteristics plus a wide versatility derived from these attributes. These attributes stem from the two fundamental phenomena of the process which are mutually related and dependent—latent-image formation followed by development and the after processes.

The first event in recording information by the photographic process is the absorption of photons, which changes the characteristics of affected silver halide crystals, producing in them what is called the "latent image."[4] This is a unique phenomenon and it is the solid-state characteristics of the minute silver halide crystals that provide the explanation.

Latent-image formation in the silver halide crystal takes place in three distinct steps. The first step is a change in the energy level of an electron in the crystal. According to the laws of quantum mechanics, an electron in a silver halide crystal, from absorption of a photon by the crystal, can have its energy state raised from a lower energy band of the crystal—which is completely filled with electrons—to an upper empty band, commonly referred to as the "conduction band." An electron in the conduction band may be viewed as shared by all the silver ions of the lattice and as continually moving about from one silver ion to another. Such an electron behaves in the manner of a free conduction electron of a metal, which, in the presence of an electric field, gives rise to electronic conduction.

The second step depends on the presence of impurities or discontinuities in the crystal lattice of the silver halide crystal. Silver halide crystals incorporated in photographic materials are generally considered to have one or more colloidal silver metal or silver sulfide specks (or some other type of "foreign" material) within the crystal lattice or on the surface. The energy levels of the filled conduction band of silver metal and silver sulfide lie just below, or slightly overlap, the energy levels of the free conduction band in silver bromide. Under these conditions, the electron passing from the silver bromide to the speck will drop to a lower energy state where it can no longer move freely through the crystal. It becomes trapped, giving this speck a negative charge.

The third step results from the ionic conductivity in the silver halide crystal due to motion of some silver ions (a very small fraction of all the ions) which have escaped from their normal positions in the crystal. Since these ions are positively charged, they are attracted by the electrostatic field formed by the electron trapped on the speck and migrate to that point.

Therefore, the formation of the latent image, as the physical evidence of the absorption of photons is called in photography, takes place when a photon excites an electron in the crystal sufficiently to place it in the conduction band. It can move freely now through the crystal until it falls through a potential into the trap formed by a silver particle, or other "foreign" material, which becomes charged negatively. The speck then attracts a positively charged silver ion to the site, thus forming an atom of silver metal. This process is repeated and the original colloidal silver speck grows in size with each photon* of radiant energy absorbed.

The second major event in recording information by the photographic process is the selective reaction of certain chemical reducing agents in providing electrons to those crystals of silver halide having in excess of a certain number of silver atoms at the speck, and the fact that those having less than this minimum number have a much lower rate of acceptance of electrons from this source.[5] Once the silver halide crystal begins to accept electrons from the developer, the reaction proceeds until all the silver halide of the crystal is reduced to metallic silver. Since the number of grains having a latent image in an area of the material is greater the higher the intensity of light incident on that area, the result is an image-wise production of metallic silver.

One important fact of this event is that the reduction of a whole silver halide crystal that has absorbed a few photons of light to silver represents amplification. In an electronic circuit, an electron produced by photon absorption in the sensitive surface of a phototube triggers the controlled flow of many more electrons from a source of electrical potential. The amplifier in the photographic material uses a chemical source of electrons, the amplification being controlled by the number of quanta needed to produce a latent image and the limit of amplification being imposed by the size of the crystal. With some crystals, the number of photons required to produce a latent image is small and the amplification is of the order of a billion times. (Figure 1)

It is important not to confuse this type of amplification development with other chemical types. One of the ex-

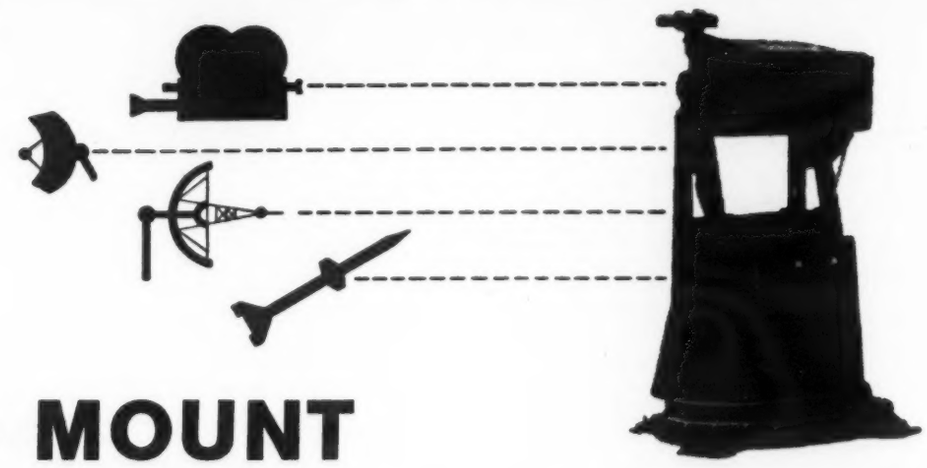
*Not strictly rigorous—see references for details.

amples of the photographic phenomenon is known as "print-out paper." This material produces a picture by exposure to radiation alone; no development process is used, and not more than one atom of silver metal is formed for each photon absorbed in accordance with Einstein's photoequivalence law. Consequently, it must be exposed for minutes to a strong source of radiant energy, such as the sun, in order to produce an image. The same is true of the other currently available photosensitive systems using a liquid or vapor for development of the image. With the blueprint process, processes based on the diazonium compounds, and other similar processes, a photon absorbed by a molecule simply makes it reactive to a chemical agent to change it from a colorless compound to one that is visible, or vice versa. Every molecule of color produced requires the prior absorption of a photon, so there is no amplification associated with these processes.

A quick review of the energy levels existing in latent-image formation and development will serve to emphasize the uniqueness of the process. First, there must be an an empty conduction band in the crystal lattice at the right energy level above the filled band such that a photon can just raise an electron from the lower energy level to the upper. Then the sensitivity speck, silver sulfide, for instance, must be at just the right energy level to trap this free-roaming electron from the conduction band of the crystal but not accept any electrons from the developing agent later. Otherwise, all crystals would develop and no image would result. Some silver ions in the crystal must be mobile and migrate to the electron on the sensitivity speck, the electron being obtainable only from the same crystal and form a silver atom in situs. Then this event, plus a few more similar ones, must change the energy level of the sensitivity speck so tha now *will* accept electrons from the developer and so duce the properly exposed crystal of silver halide silver. Statistically, it appears that these are a set unique phenomena. For instance, there is good evide that a "latent image" is formed in thallous bromide the same general mechanism as just discussed for silver halides. However, there is no known way to devel it directly; the thallous bromide can be converted to silv bromide, after exposure, and in this indirect way us as a photographic process. Mercury halides also w form a latent image which can be chemically develope but the efficiency of latent-image formation is compar tively very low.*

At this stage in the evaluation of the characteristi of this new process, it appears that the photographic ar plifier has three important advantages over other type

*While the existence of these exact energy levels and energ level differences in the silver halide crystals matched with those certain chemical reducing agents is extraordinary, the technologic techniques that apply these phenomena to provide a practical, co venient method of recording radiant energy are no less remarkabl The silver halide crystals—photoconductors like lead sulfid indium antimonide, etc., and essentially of the same genera phenomenon as transistors—must be (1) made by the millions i a suitable matrix; (2) modified by physical and chemical opera tions to provide specified characteristics, and (3) coated in layer sometimes 0.0001 inch thick, up to 50 inches wide and mile long (the thinness controlled to 0.000003 inch for this vast area) This, in order to provide a radiant-energy recording system tha (1) yields to a specified level and type of radiant energy the sam results in any square millimeter of its matrix or the matrix of similar material made a year hence and (2) possesses the sensi tivity, image quality and response to intensity variation require for the intended applications. No wonder it has been stated tha photography could not be predicted from a consideration of th scientific principles involved—it had to be "discovered" or "in vented."



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first, the amplification step can be delayed, in some cases almost indefinitely; second, it has a tremendous information-to-amplifier size and complexity ratio, and third, it uses the universal liquid, water, in the "amplifier."

The fact that the amplification step can be delayed is extremely important where weight is a factor, such as in aerial photography, missile photography and outer-space photography, because it is unnecessary to transport an amplifier and its associated power source during the recording operation. This characteristic has only recently become available. When the wet development process was first discovered, it was necessary to prepare the sensitive layer, expose it and process it immediately while it was still wet. Figure 2 shows an engineer setting out to perform experiments in the field shortly after the development phenomenon had been discovered. All of the equipment he is carrying was necessary in order to record images by this process. Progress in the development of this new technology has been extremely rapid, and photographic materials available today can be kept for long periods, before and after exposure, before the development process is required.

On the other hand, in this short space of time, the processing steps have been markedly reduced in complexity so that if it is necessary to perform the amplification step at the time of recording, an extremely compact device requiring minimum power can be constructed. Figure 3 shows the amount of solutions required to amplify the 120 images, 4½ by 4½ inches in size, on a 5-inch by 50-foot length of a high-quality aerial film using well-designed experimental equipment.*

The amount of data which can be recorded, to be used immediately or stored for future reference, is amazingly large. The film mentioned in the preceding paragraph will resolve in excess of 350 lines per millimeter and can be exposed from an airplane in full sunlight at about 1/400 second with an f/5.6 lens aperture. Using a very conservative figure of 3.5 microns as a reasonable size that can be distinctly recorded, and assuming a conservative number, 8, of shades of densities between density limits of 0.25 to 2.5, with this film, one can record 150 million bits of information per square inch.* The area of the film which can be exposed in each 1/100 second is limited only by the size and efficiency of the mechanical and optical equipment available, which is, of course, the limit on the total number of bits of information that can be recorded by a single exposure. However, take for example, not the largest nor the smallest size equipment for illustration, but one that will expose a 4½- by 4½-inch area at a time on a roll of film. A 50-foot roll of film, 5 inches wide, can easily contain 120 4½- by 4½-inch pictures which represent at least 3.6×10^{11} bits of information.** If necessary, this length of film could be exposed in less than 2 minutes.

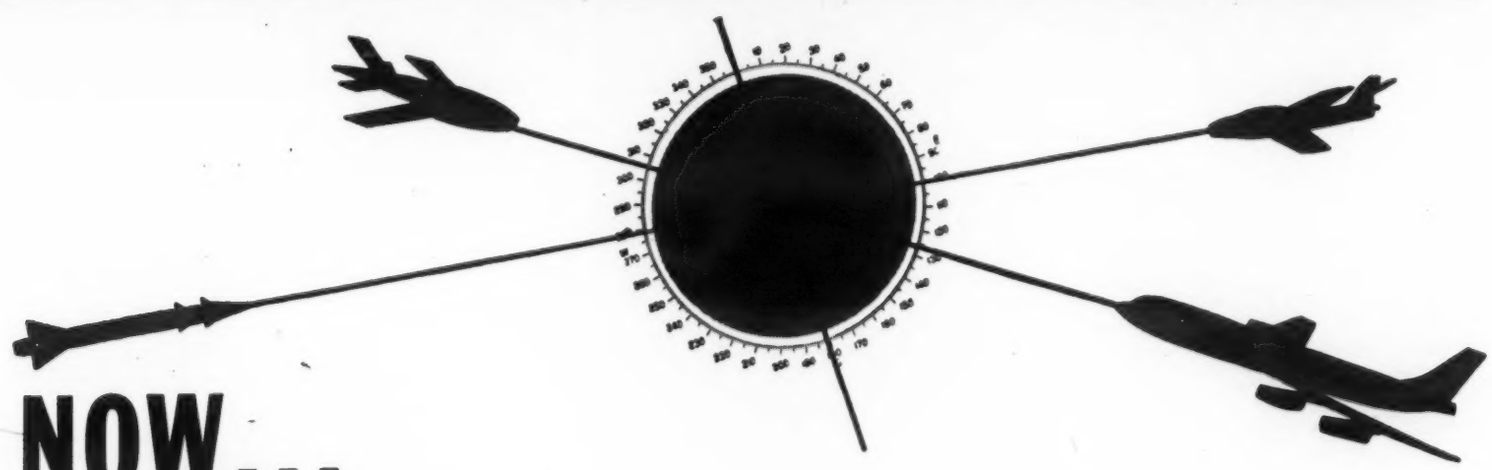
The advantages of using water in the amplifier are evident for many applications, but particularly for military operations in the field. Wherever man is he must have water and since it is the most universally available liquid the advantages of its use instead of, for instance,

*The equipment size could be less than 5 inches by 5 inches by 5 inches.

*This total number of bits was calculated on the basis that the 8 density levels represent only 3 bits of information where a bit is defined as $\log_2 N$.

**To transmit the 3.6×10^{11} bits of information from one point to another on a 10-megacycle bandwith would require at least 5 hours.

(Continued on page 88)



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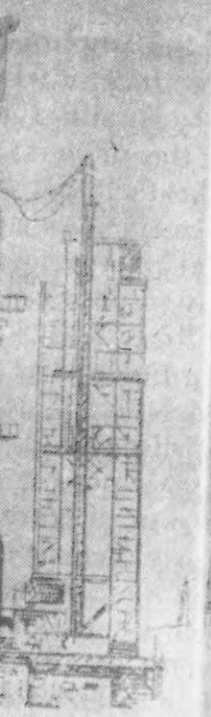

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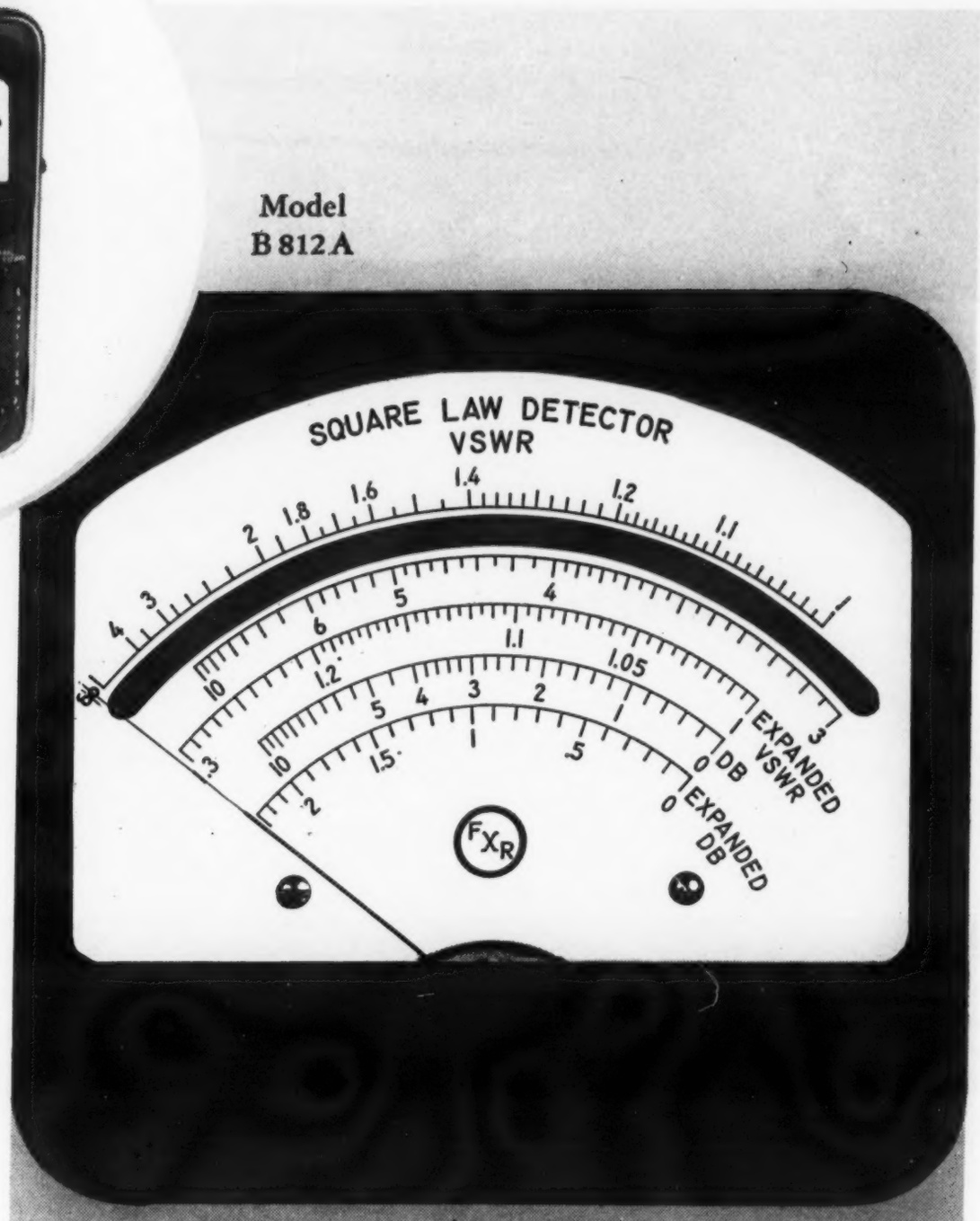

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progress and survival

by **DR. RUSSELL H. VARIAN** — Chairman of the Board — Varian Associates

THE SURVIVAL OF THE FREE WO against the totalitarian threat communist Russia in the long r depends more on our rate of progre than it does upon our volume hardware. For the volume of har ware is inextricably tied to the pr ductivity of our economy, and coul not be expanded by a factor of mor than 3 or so even in a most dir emergency; whereas the rate of prog ress is a very expandable or contrac table thing and is much more sensi tive to the way we do our research and development than to the total money spent on defense.

The amount of money that can be spent on making progress is strictly limited by the number of people capable of doing the research and development on which this progress depends. Hence the amount of money which can be spent on making progress has a definite upper limit, but the amount of progress made can vary over very wide limits, depending on the way this research talent is employed. There is good reason to believe our research talent is not being employed to the fullest at the present time. The fault underlying most of our present efforts is that the emphasis is on obtaining hardware more than obtaining progress.

The bulk of our industrial effort is, and probably always will be, directed toward obtaining usable hardware, but if we think that this is our main bulwark of defense we are very wrong. Any war in the future will be decided by quantity and quality of the hardware more than actual manpower, and if the quality of the hardware is much below that of the enemy no quantity can compensate for this deficiency. Hence the smaller part of our expenditures may be the crucial factor in the next war, if it should occur.

The great fault of our present procurement is that for the most part the thought first centers on weapons systems and appropriations are obtained primarily for these systems, but the weapons system is drastically limited by the components that can be put into it. Two alternatives are possible —(1) that the design of the weapons system is limited to the components that are already proved to work, and (2) that it be designed around some components which would greatly improve the performance of the weapons system, but have not yet been proved. Both approaches have been followed with bad results. In the first

case the new weapons system constitutes too small an advance over the system that preceded it. In the second case, either long delays, or complete failure, are almost inevitable. The fact is that to make rapid progress we must accept gambling on ideas as a basic philosophy. But, here the question is, where should we gamble on ideas?

It should be clear that weapons systems are not the proper place to do such gambling. In a huge combination of parts one part that is a failure can wreck the whole system. For example, if you had ten parts in a system that all had to work, and there was a fifty-fifty chance that each one would work, the chance that the system would work would be about one in a thousand. Thus, it should be obvious that gambling on systems is far too expensive. The gambles should have been taken individually before the system was designed.

To make most rapid progress, gambles of varying probabilities of success must be taken. If all of a group of alternative ideas have a relatively small pay-off in progress, then the gamble should be taken on one that has a high probability of success. However, if one idea has a huge pay-off in progress, but a low probability of success that gamble should be taken, but already engineered systems should not stand or fall on its success or failure.

The highest talent of a research man is the ability to make wise decisions between hosts of possible gambles and select those which will provide him with the most rapid and economical progress toward his goal. It can be stated, as a general principle, that any gamble should be reduced to the simplest and most economical one that will produce significant results, and that only after significant results, which constitute building blocks, have been achieved should they be constructed into a larger edifice.

It is not intended to imply that exploratory systems work should not be done before components are available. This kind of work is very useful in tracing through the foreseeable results of new concepts and in outlining needs for new components. Also new components make new systems concepts possible. Some people seem to think that the military man can tell the systems man what he wants and the systems man then tells the components man what he wants and that this can result in good systems. If a military man were asked on a purely uninhibited basis what he wanted, he would reply that he wanted a weapon, or weapons, that would win all wars and that no potential enemy could copy. Actually his requests will be much more specific and will be limited to things that he thinks are within reason. But how does he know what is within reason? Actually he doesn't know precisely—nobody does. Figuratively the ball must be passed back and forth many times between military, systems, and components specialists before anyone knows what is reasonably possible and desirable in the existing state of the art.

All this results in lots of thinking and talk and correspondence and no hardware, and therefore nothing concrete has been bought. Hence, why pay for it? Also, this sort of interchange runs contrary to the security concept of "need-to-know." Need-to-know generally means need-to-know in order to produce hardware, not need-to-know in order to think or to invent.

I would say that the present situation is that the gambles are too small and that they are contained within units that are too large. It has been mentioned that the highest talent in the research man is his ability to choose wisely between a host of possible gambles. Those who are engaged in placing government contracts are either placing orders for things already known, or they are making choices between possible gambles. If they are doing the latter all the work of those who will ultimately be connected with the projects supported is effective or ineffective, depending on the wisdom of the choices made. It is, therefore, rather obvious that these men should be of the very highest possible research caliber, and that they should be backed up by men higher in the organization who understand perfectly what is being done.

It is difficult to see where to begin, or how to establish a good system of contracting, but until we do we will be wasting a major part of our national research strength.

The following statement by Mr. Julian K. Sprague re-emphasizes the importance of components as covered throughout the March issue of SIGNAL. Mr. Sprague, President, Sprague Electric Company, reaffirms the role which reliable components must play in the electronics field if our production objectives in this Space Age are to be progressive and of national economic value.

Electronic components are the basic working elements which are assembled by end equipment manufacturers into an infinite variety of devices from radio sets to giant computers, and from VT fuses to integrated fire control systems. The reliability of these building blocks determines the reliability of the end equipment since the failure of a *single* component can cause the failure of the whole, except in those cases where redundancy is used.

As computers and weapons systems have become more and more complex, there has been a corresponding increase in the number of components used. This, at long last, has led to a general realization that a fantastic increase in component reliability is necessary if the end equipment is to work at all. Hence, the intense effort now underway on "high reliability" in components research, development, evaluation, and manufacture.

THE IMPORTANCE OF ASTRONAUTICAL RADIO IN THE SPACE AGE

by

Andrew G. Haley

President of the International Astronautical Federation
and General Council of the American Rocket Society

THE CLOSER we get to the moon, the farther away individual nations retreat from considering the legal problems of outer space. For example, at the Colloquium on the Law of Outer Space held on August 29, 1958, at The Hague under the auspices of the International Astronautical Federation (IAF), the USSR sent no spokesman—although urgent invitations had been delivered to USSR experts. Even the United States authorities do not seem to believe that the provisions concerning international cooperation contained in the National Aeronautics and Space Act, signed by President Eisenhower in August 1958, cover the legal and social implications of space exploration and travel.

The use of radio in outer space presents one clear example of the blindness of some statesmen who do not realize that law must precede both vehicle and man into outer space.

At the present time radio engineers throughout the world are possessed with the unpleasant knowledge that for indeterminate periods the frequencies 20.005, 40.002 and 108.00 megacycles (and possibly others) are in a sense usurped for Sputnik, Vanguard and Explorer operation to the posssible detriment of assigned frequency usage. One must understand that the radio spectrum is very limited and that the frequencies involved are extremely valuable and they may be quite essential to some other services. To "tie up" radio frequencies in this fashion requires international consideration.

In Chapter III, Article 5, of the Radio Regulations annexed to the International Telecommunication Convention, it is provided that the worldwide standard frequency shall be the channel 19.990-20.010 megacycles. The seriousness of this assignment may be understood from the fact that on this channel time signals are broadcast and the time signals are monitored throughout the world. For example, in the United States, Station WWV, Washington, D. C., transmits the official time signals and constant checks on these time signals are made at various points, such as the Bureau of Standards radio reception center in Boulder, Colorado. This reception has actually been interfered with by the transmission from Sputniks. Furthermore, the Bureau of Standards maintains chains of recording stations for radio noise measurement in areas throughout the world and these stations operate on the quiet part of the guard band of the standard channel of 20 megacycles. These stations also have been interfered with by the Sputniks. It is true that the period of interference has not been great, but if the United States follows the lead of the USSR in derogating the standard frequency, and if the combined number of earth-circling satellites should aggregate as many as 60—which the United States and the USSR have publicly projected—then interference would become serious indeed.

The first U. S. satellite utilized the frequencies 108.00 mc and 108.03 mc —frequencies allocated to the Aeronautical Radionavigation Service. But this use was well publicized in advance, and, in fact, the use of the frequencies was "cleared" on an international basis. Later, however, the United States utilized two frequencies in the FM broadcasting band in spaceflight applications. The frequencies 107.94 and 107.97 mc were used in the Atlas ICBM program during 1958 and 1959. Both frequencies are in the FM broadcasting band. Yet no effort was made to coordinate the use of such frequencies with users of the FM band.

The United States probe, Pioneer IV, projected toward a solar orbit March 1959, utilized a radio frequency (960.05 mc) allocated on a worldwide basis to the Aeronautical Radionavigation Service.

The situation is of particular concern as the individual problems are completely controllable if handled at this time. The nations of the world must immediately adopt international regulations providing for safety of life and property in space, providing for the control of the landing of any satellite and providing for the control of radio transmissions from objects in space. All these matters should have been the subject of international agreement before the first Sputnik was projected into outer space. Fortunately, extensive efforts are under way to achieve world agreement on this subject.

In view of the importance of radio frequencies to the astronautics program, I traveled to Warsaw to attend the International Radio Consultative Committee (CCIR) Conference in that city during August 1956, to present the views of the International Astronautical Federation which were based on the expert advice of scientists from several countries. I proposed that the CCIR undertake a review of the requirements of astronautical radio frequencies and promised the cooperation of the IAF in this endeavor.

On May 10, 1957, the International Astronautical Federation received from the International Telecommunication Union (ITU) full nongovernmental consultative status.

A meeting of Study Group XI of the CCIR was scheduled to be held in Moscow from May 28-June 10, 1958. I attended the meeting, which was concerned with various aspects of television systems, television standards, and requirements for the transmission of television over long distances. In Moscow it was decided

that the questions, problems and study proposals which were submitted by me to the Plenary Session could better be acted upon by Study Groups V and VI, and the Director of the CCIR proposed a detailed program which is now under way.

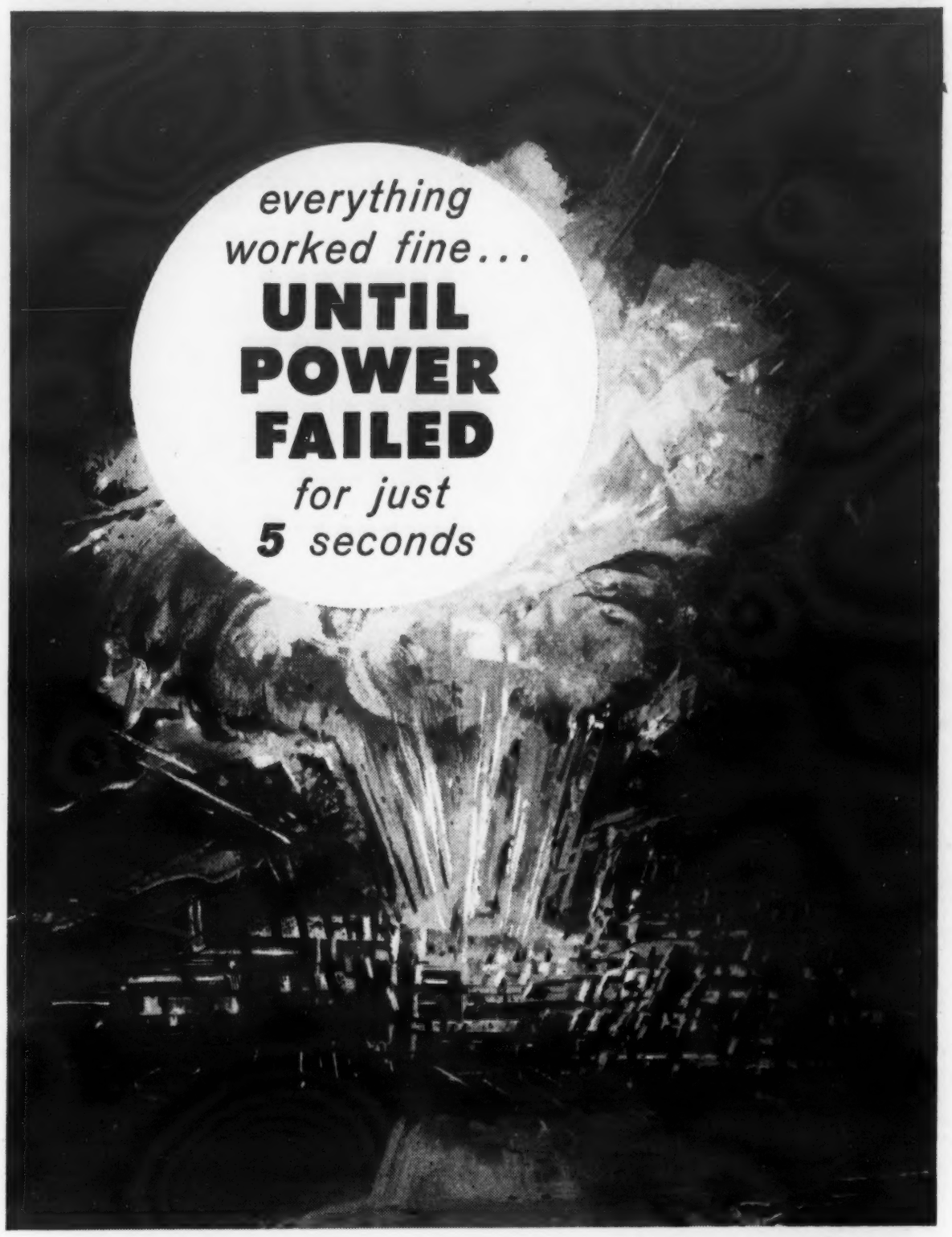
In addition, the United States Preparatory Committee — International Radio Conference, which is considering the program of CCIR Study Group VI in anticipation of the Ninth Plenary Assembly of the CCIR being held in Los Angeles in April 1959, has circulated a proposal based upon findings that "observations of radio emissions of the first earth satellite have already yielded valuable information about the ionosphere, as well as about problems of space travel," and the Committee recommends that "clear channels be set aside for the use of satellite and space ship emissions."

The American Rocket Society has filed pleadings and scientific astronautical reports and comments in proceedings instituted by the Federal Communications Commission looking toward reallocations and new allocations of radio frequencies to the various services, including astronautical radio.

The means of effecting the necessary controls, from a technical standpoint, are comparatively simple—that is, the space vehicles should contain control or "destruct" mechanisms which would be activated by radio command frequencies. It takes as much energy to bring a satellite back to earth as it does to project it into orbit. However, the orbit may be altered by very small applications of thrust, and if altered in the direction of the earth's atmosphere the consumption of energy will then become a function of atmospheric friction.

The main point is that we cannot shoot down a satellite. By shooting a satellite we would only create a worse condition because the object would then become fragmented but nevertheless continue on in orbit. Furthermore, those Sputniks which have returned did not atomize in the atmosphere but descended in sizable chunks. There is no guarantee that these chunks of metal, at present absolutely uncontrolled, will not prove to be a lethal metallic rain on the Empire State Building or, for that matter, on the Kremlin.

In a word, the statesmen of the world must awaken to the fact that by ignoring the legal and sociological problems of space exploration, especially as to radio frequencies, they are leaving the door open to social and scientific pandemonium.



"We had five fast moving bogeys in radar contact and had started the defense process. Then . . . power failed. In five seconds we were back in business, but our scopes showed only four targets. We passed on the information. Defense got all four . . . but the fifth got through . . ."

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Completely integrated for airborne targeting and surveillance, the Swallow will provide at Army Corps and Division levels, a system capable of rapidly and accurately pinpointing enemy target positions. The system achieves full battlefield effectiveness for the new family of Army weapons.
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Republic Aviation Corporation has the complete systems responsibility for the Swallow development, working in close cooperation with U. S. Army Signal Corps Research and Development Laboratories at Fort Monmouth, N. J. and the Army Combat Surveillance Agency, Arlington, Va.
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AIR NATIONAL GUARD COMMUNICATIONS AND ELECTRONICS CONFERENCE REPORT

SINE WAVE of the RCA Electronic Music Synthesizer is explained by Dr. H. L. Donelly, RCA, center, to Col. John A. McVey, right, and Lt. Col. Walter E. Coddington at the Conference.

by Capt. Francis N. Satterlee, USAF
Asst. Information Services Officer
Hqs. Ninth Air Force
Shaw Air Force Base, South Carolina

HEADQUARTERS NINTH AIR FORCE, SHAW AFB, S. C.—Electronics and communications experts from the Air National Guard and their United States Air Force advisors representing 44 Air National Guard units in 20 states concluded the fourth annual communications and electronics conference March 27th at Orlando Air Force Base in Florida.

Since its inception during 1956, the annual meeting has been sponsored by Tactical Air Command and hosted by Ninth Air Force's 507th Communications and Control Group from Shaw Air Force Base, South Carolina.

Opening the 1959 session was the official host for the event 507th Commander, Colonel John A. McVey, who introduced TAC's Ninth Air Force Commander, Major General D. W. Hutchison.

In his opening remarks, General Hutchison told the conferees that during his former assignment at Tactical Air Command Headquarters he had become closely associated with the activities of the Air National Guard, especially so, since many of the standby units would be placed under his command in the event of a national emergency and mobilization.

General Hutchinson termed the *Ready Now* concept as being the "single over-riding doctrine of the reserve program."

"It is the need for a continuing, immediate operational capability—a constant striving for a higher state of readiness with ever increasing effectiveness," commented General Hutchison.

Continuing, he made clear that "we (the United States) can no longer depend upon a warm-up period, wherein, we can build up and train combat forces. To expect to be able to call up and then train for an indeterminate period as we did in World War II would be suicidal today. Like the active units, you must be capable of providing a force that is READY NOW."

Next, Major General Winston P. Wilson, Chief of the Air Section, Air National Guard Bureau, spoke to the group about the Guard bureau in Washington, D. C., and its responsibilities for the supervsion of all ANG units.

Intermingled with the military speakers from the Tactical Air Command, Continental Air Command, Air Material Command and USAF Security Service, were representatives of the communications industry.

The industry communications and electronics experts presented five lecture-demonstrations of the latest research projects, some of which are planned for future use in the Tactical Air Command and Air Nati Guard units.

Doctor H. L. Donelly of R Corporation of America den strated the most recent electronics search in solids, sound and space the opening day. His demonstra of the "miniaturization of televisi was of particular interest to the ferees. The camera he used is s lar to those planned for use in "Space Age."

The latest trends in the deve ment of single-sideband type ra communications were discussed Mr. Paul J. Cahan of Kaiser Airc and Electronics on the second da the conference.

Mr. Lyle L. Gilberson from the Paul, Minnesota branch of the R ington Rand Corporation, explai the functions and capabilities of latest semi-automatic data hand equipment used in ground con intercept radar systems.

Representing the General Elec Company was Mr. John J. Skeb who discussed the most recent velopments in GE's "All Weap Control Systems."

Final industrial representative pearing before the conferees was Raymond Strimling of the Kl schmidt Division of Smith Corc Mr. Strimling explained the curr research programs in the teleprin field.

Air Force speakers discussed Unit Training available to the National Guard, Concept of the C posite Air Strike Force, Organizat and Activities of the 507th Com nications and Control Group, Tact Air Command's Guided Missile P gram, and Communications Secu Procedures.

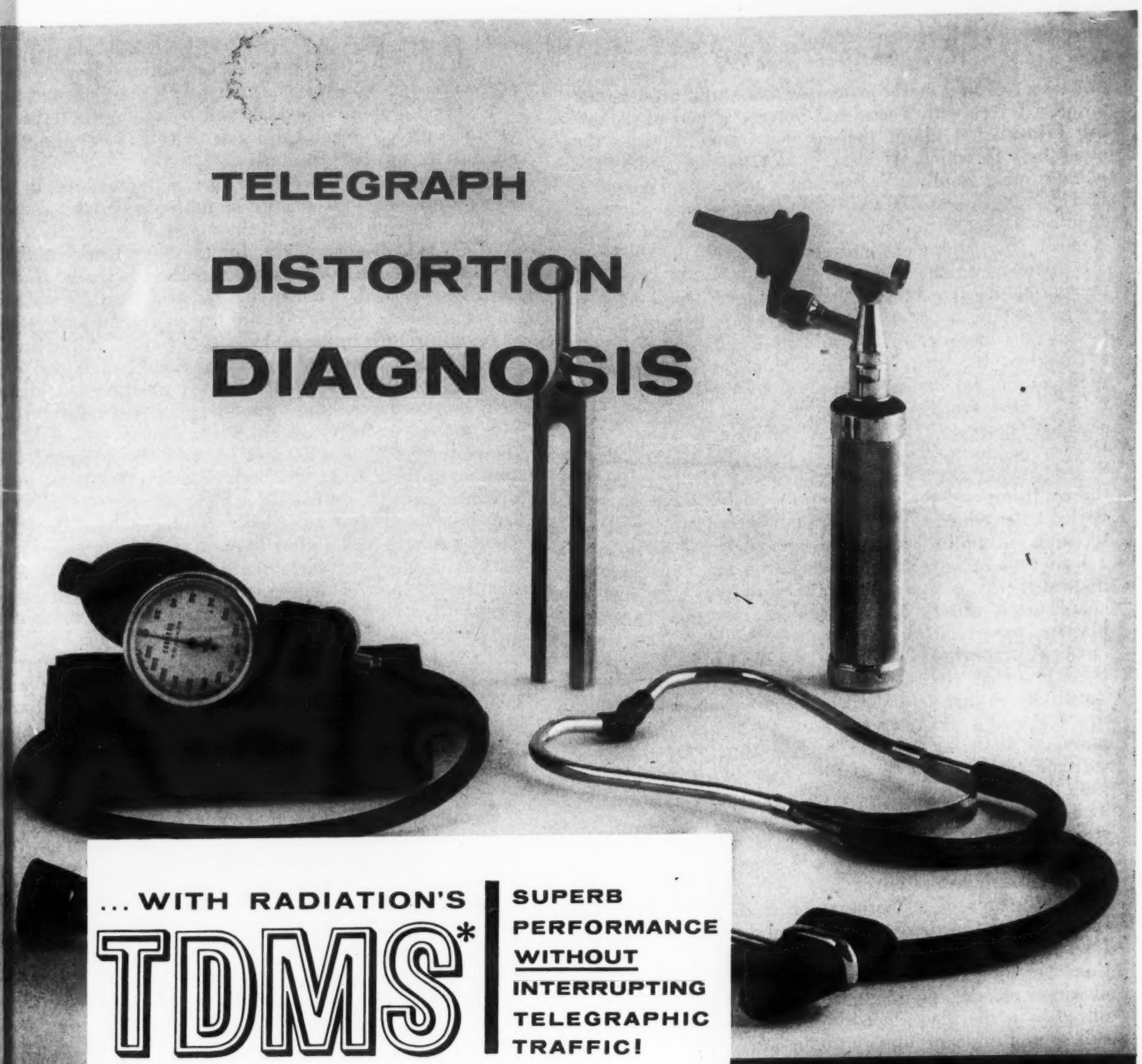
Colonel William R. Nevitt, Dep Commander of Nineteenth Air Fo briefed the group on Exercise *D Cloud-Pine Cone* which will be c ducted from May 23 through June in the vicinity of Ft. Bragg, N. C.

The 1959 communications a electronics conference concluded March 27th with a group discuss participated in by all representati attending the conference.

First two of the conferences, wh have now become an annual eve were held at Shaw Air Force Ba South Carolina where the Ninth Force and 507th Communications a Control Group maintain their he quarters.

During 1958, the meeting site w moved to Orlando AFB in Flori where conference facilities have be constructed for use by USAF orga zations throughout the Easte United States.

TELEGRAPH DISTORTION DIAGNOSIS



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(Continued from page 77)

gasoline, to run a motor-generator set should provide our military forces with a new and potent method of gathering information about the enemy, in addition to the other uses to which the process can be put. While the photographic amplifier is reasonably simple and compact, it should be emphasized that when the desired application requires that the best characteristics of the process be retained, the equipment must be very carefully designed and matched to the material and the process. Furthermore, the equipment must be designed, serviced and maintained by well-trained photographic engineers and technicians in order to realize its full potential.

Photographic materials have applications in many fields of human endeavor because of their great versatility. This versatility rests on the fact that the individual sensitive elements can be varied in area by about 1000 times to produce a wide gamut of basic sensitivities, while the chemical nature of the environment of the crystal—the emulsion and the processing chemistry used—can be varied to produce the desired tone-reproduction characteristics. In addition, the emulsion can be sensitive from 1.4 microns in wavelength down to the wavelength of the highest-energy cosmic rays. The sensitive layer can be coated on a variety of support materials, such as glass, plastics, paper, metal, etc., to provide physical and mechanical properties suitable for the multitude of applications intended. It can be made to have extremely high sensitivity so that very short exposures can be used. Figure 4 shows a picture made only by moonlight and exposed at 1/10 second at f/1.3 aperture. At the other extreme, the image-quality characteristics can be made so high that they exceed the best optics that can be designed. This high definition is useful, for instance, in reducing storage space of documentary material, as exemplified by the fact that twelve 8½- by 14-inch pages of material plus digital information can be placed on a 16- by 32-millimeter area of a photographic material designed for the purpose. (Figure 5) A most important characteristic for some applications is that it can integrate dim radiation over long periods, if necessary for days, in order to obtain a record. The amount of density difference produced by a specified intensity difference can be varied to suit a multitude of tone-reproduction requirements. Of somewhat lesser importance, perhaps, to the data-recording applications is the fact that black-and-white "paintings" of natural subjects can be made with these materials and just recently chemical processes have been devised that convert these pictures to full color.

An important general characteristic is the reliability of the material and the system with which it is employed. Seldom have there been instances when a proper image was placed on the sensitive material and a record was not obtained. The mechanical-optical device, known as a "camera," used to expose the material is also very reliable. Millions of simply made cameras are in use with consistently satisfactory results in almost all cases. This reliability is of extreme importance in military and certain commercial applications where the failure of a single component can result in the failure of an expensive test or operation.

To summarize, the characteristics of photography that make it useful for communication applications are: (1) Excellent reliability, (2) High sensitivity, (3) Excellent sensitivity-image quality ratio, (4) Low weight-information volume ratio, (5) Broad spectral sensitivity range, (6) Low-intensity summing ability, (7) Great versatility, (8) Simplicity of operation, (9) High amplification factor (10^8-10^{10}) and (10) Amplification delay characteristic.

With all of its favorable characteristics, the proc
not without its disadvantages, of which there are tw
1. Photographic scientists and technologists hav
yet been able to extend the sensitivity beyond abo
microns in wavelength.
2. High density levels of dust and moisture i
atmosphere, such as fog or clouds, absorb the ra
energy bandwidth to which the material is sensitive

These two disadvantages, for the time being, ma
necessary to use other more complex methods if
must be recorded at longer wavelengths than 1.4 mic
or when clouds or fog obscure the subject of interes

Now to return to the real cloud of today. In the he
almost chaotic, atmosphere now existing, it is not
the duty of the individual scientist and technologis
help keep order in this own discipline, but also to
vide a true summary of situations in his own field
the guidance of his colleagues in other disciplines. In
coming space age, as has been true in other eras, m
problems will be confronted which, as Spencer and M
lan imply, can be solved by photography. Howev
photography is so familiar to most of us from associat
with it in our very early years as a method of maki
pictures that we seldom consider it as a tool of "co
munications." Then, too, its fundamental principl
which are based on chemistry, physics and mathemati
are not widely investigated in academic circles and
not, therefore, become a part of the knowledge of mo
graduates of institutes of higher learning. This familiari
with "photography as the best way to make a picture
has led to laxity in considering the fundamental pri
ciples of the process when a "communications" proble
is evident, and surprisingly enough, this laxity exten
even into the erudite photographic fraternity.

It is hoped, therefore, that our little fantasy may brin
the true character of the photographic process into bett
focus for engineers and organization managers. Whi
simplicity is an outstanding characteristic of the proces
it is gained only by the existence of an extensive suppor
ing technology. When new chores are planned for th
most willing servant, it should be realized that th
process, equipment and materials may need to be change
to fit the new requirements. As in any technology, the
changes cannot be efficiently wrought without the ser
ices of trained and experienced scientists, engineers an
technologists, with the consequent expenditure of bot
time and money. Properly used, this extraordinary, i
triguing and unique process will continue to serve ma
kind as a memory aid for his more pleasant moments an
as a recording communication tool for his more arduou
pursuits.

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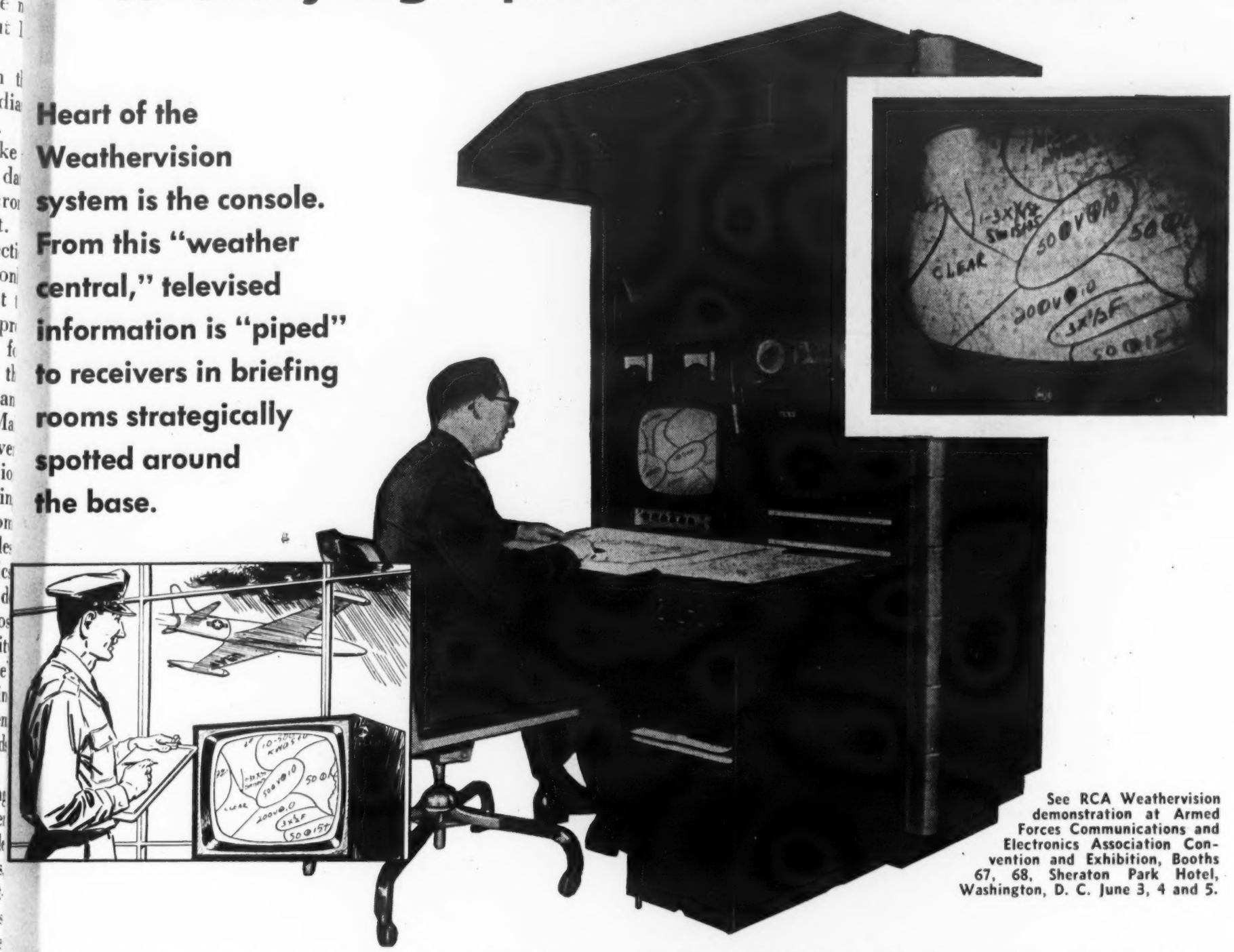
January 1958.

RCA Weathervision sends the weather briefer to every flight point at the same time!

Heart of the Weathervision system is the console. From this "weather central," televised information is "piped" to receivers in briefing rooms strategically spotted around the base.



See RCA Weathervision demonstration at Armed Forces Communications and Electronics Association Convention and Exhibition, Booths 67, 68, Sheraton Park Hotel, Washington, D. C. June 3, 4 and 5.

RCA Weathervision is closed circuit television, designed to provide accurate, up-to-the-minute forecasts to pilots and other base personnel concerned with flight conditions. It saves time and manpower, provides additional hours for the weathercaster to study conditions and prepare his briefings. With RCA Weathervision only one forecaster is needed to brief all locations simultaneously. Flying and administrative personnel can consult with forecaster at all times. All voice transmissions are taped for future reference.

RCA WEATHERVISION...A COMPLETE PACKAGE FOR WEATHER BRIEFING

The RCA system consists of the console, or originating location; the distribution system; and the receiving system. RCA can supply the complete package, providing all equipment plus installation supervision and nation-wide service where needed—assuring maximum convenience, dependable performance.

Console—The Weathervision console contains a TV camera focused on a data table on which are weather charts, other data. Viewing monitor above table shows picture seen at receiving locations. Microphone, speaker and amplifiers provide for communication between weathercaster, receiving personnel.

Zoom Lens—An innovation in weathercasting, providing continuous coverage of display area as focal length of lens is varied. Permits uninterrupted viewing, eliminates blackouts caused by turret turning. Provides smooth transition from wide angle to close-up views.

Ease of Operation—Only one adjustment—light level control —required at beginning of briefing. During briefing, only the zoom lens control is operated.

Receiving Locations—High quality TV monitors or receivers are used. Facilities allow pilot and administrative personnel to ask questions, receive answers.

Complete brochure on RCA Weathervision will be mailed on request. Write to RCA, Dept. T-291, Building 15-1, Camden, N. J. In Canada: RCA VICTOR Company Ltd., Montreal.

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New Chapter Chartered At Santa Barbara

AFCEA's newest and forty-eighth chapter was chartered at Santa Barbara, California, May 8, 1959.

The officers who will form the interim Board of Directors are: RAdm. Clarence E. Ray, USN, Ret., president; Lt. Col. Holman H. Dillard, USAR, Ret., first vice president; Maj. Richard R. Luce, USAF, second vice president; Walter W. Montgomery, secretary, and Roger A. Moe, treasurer.

Geographically, the chapter will include Santa Barbara, Vandenburg Air Force Base and Point Mugu. Other chapters in California are located in Sacramento, San Diego, San Francisco and Southern California (Los Angeles).

The Working Committee for organizing the chapter was composed of the officers and the following members: Ray L. Dawley, David H. Evans, Cdr. Ormond E. Hearn, Brig. Gen. Winston W. Kratz, USAF, Ret., George J. Maki, James R. Merrill, Adm. Stuart S. Murray, USN, Ret., Lt. Joseph N. Nay, R. C. Raymond, Ralph F. Redemske.

Others include: Paul A. Scholz, James F. Sears, Lt. Cdr. Norbert C. Vojta, USN, Ret., and Capt. Robert G. Williams, USMC.

Service Academy Awards

The Association's awards to the students attaining the highest average in Electrical Engineering and Electronics at the three service academies will be presented during June Week ceremonies.

Clock radios donated through the courtesy of Sylvania Electric Products, Inc., will be awarded to these students. The names of the award winners will not be known until the final grades have been computed.

Rear Admiral Frederick Furth, Vice President, ITT Corp., and AFCEA National President, will present the award at West Point. Rear Admiral Frank Virden, Director, Naval Communications, and AFCEA Second Vice President, will make the presentation at Annapolis.

For the first time, the award will be presented to an Air Force Academy graduate. This year's class is the first graduating class at the Colorado Springs Academy. Major General Gordon A. Blake, Commander, United States Air Force Securities Section, San Antonio, Tex., and an AFCEA Director, will present the award, which will be known as the Major General Herbert A. Dargue Award.

Astro-Electronic Products Division of Radio Corporation of America

The Astro-Electronic Products Division of Radio Corporation of America of Princeton, New Jersey, has become a group member of AFCEA. This RCA Division is active in satellite and space vehicle work.

The company representatives to AFCEA will be: Barton Kreuzer, Manager, Marketing; Carl W. Zemke, Manager, Operations Control; Sidney Sternberg, Chief Engineer; Donald L. Gunter, Manager, Market Development; Ralph A. Teare, Manager, Negotiations; M. G. Staton, Administrator, Planning; Spencer W. Spaulding, Manager, Advanced Project Analysis; Sidney Metzger, Manager, Communications & Instrumentation; K. G. MacLean, Leader, Engineers, and Fred H. Gedicks, Manager, Contract Administration.

Reprints Available

Reprints of the following articles published in SIGNAL may be purchased for $.10 a copy by writing to the editor:

"What Price Frequencies?" by Maj. Gen. Alvin L. Pachynski, Director of Communications-Electronics, U. S. Air Force, Jan. 1957; "Dispersal Is More Than Defense Against Disaster" by Oliver J. Greenway, Vice President, International Resistance Company, May-June 1955 and "Our New Air SAGE Defense System" by Maj. Gen. Gordon A. Blake, Director of Communications-Electronics, U. S. Air Force, January-February 1956.

In Memoriam

Arthur B. Goetze, President of Western Electric Company and a company representative in the AFCEA group membership, died recently. Mr. Goetze had been president of Western Electric since 1956 and a director of the company since 1953.

Brigadier General Harold G. Hayes, Chief, Combat Development and Operations, Office of the Chief Signal Officer, died at Walter Reed Army Hospital recently. Previously, General Hayes was Signal Officer, Eighth Army, Japan.

NEW AFCEA MEMBERS

Listed below are new members of the AFCEA who have joined the Association during the month of March. Members are listed under the Chapter with which they are affiliated. The April listing will appear in the June issue.

ARIZONA

Lt. Col. Louis F. Kruse
1st Lt. Yale D. Weatherby
Charlie Wesner
Lt. Col. Griffith E. Cook, Jr.

ATLANTA

Thomas H. Daniell

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S-Sgt. Merrill A. Carter
Capt. William H. Purkhiser
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1st Lt. Edward F. Jansen
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Col. Paul T. Snowden
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William A. Williamson

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2nd Lt. Larry G. Hunt
2nd Lt. Barry A. Schulman
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John H. Worth
J. Allen Mohn
James G. Kelsey
Lt. Cdr. Ogden S. Sked
Lt. Col. Glenn M. Vinquist
Capt Robert A. Kulinyi
Maj. Claud D. Hamilton
2nd Lt. Howard B. Ness
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Capt. Dean R. Woodward
James G. Aldrich
Maj. Everets R. Buchanan
Rudolph C. Riehs
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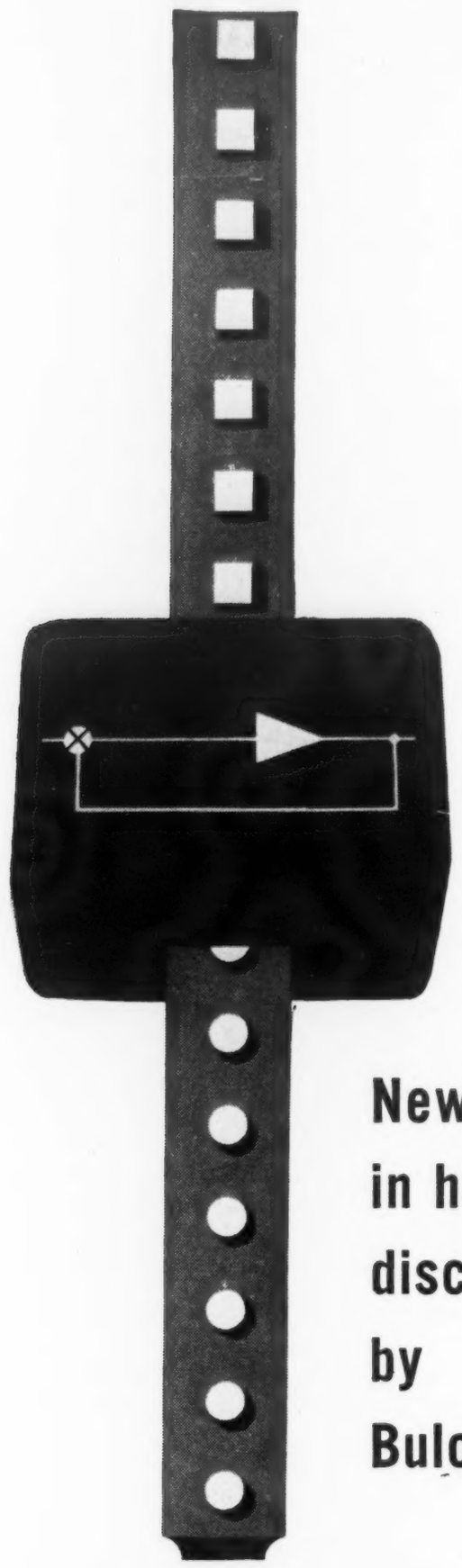

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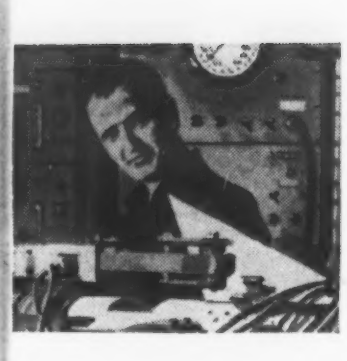

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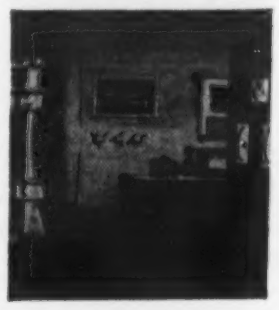

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Chapter News

Arizona

Representatives from the various Technical Departments of the Army Electronic Proving Ground described the work of their departments at the chapter's March 3rd meeting.

Arrangements for the meeting were made by Lt. Col. Lawrence R. Klar.

Augusta-Fort Gordon

The chapter heard Arlon J. Svien of Tulsa, Oklahoma, discuss a new radio system at its February dinner meeting.

Svien, departmental research and development chief of the Collins Radio Company in Tulsa, described "The Tropospheric Scatter Communications System" to 70 members and guests who met at Fort Gordon's Buck Lodge.

Svien pointed out that electronics men throughout the country are keeping an eye on a new "tropo" system already being used to relay television signals between Miami and Savannah. The success of this experiment, he said, could lead to widespread use of the new system.

Lt. Robert Price of the 362nd Signal Company at Fort Gordon directed a tropospheric scatter terminal display after Svien's speech.

Attending the meeting were representatives of the Army Signal Training Center, the Southern Bell Telephone Company, the Georgia Power Company, and the Savannah River Project, plus other electronics technicians from the Augusta area.

The chapter added the Fort Gordon Post Commander to its rolls, welcomed a lifetime member, and heard its Regional Vice President speak at its March 20th dinner meeting.

The speaker, Kelly Mosley of Atlanta, is Southern Bell Telephone Company's Assistant Vice President for public relations. He outlined the history of AFCEA from pre-World War I days to the present, and discussed recent advances made by the Signal Corps and the Bell System in developing electronic gear for military and civil defense.

Augusta-FortGordon — Shown during the March 20th meeting are, left to right: AFCEA Regional Vice President Kelly Mosley of Southern Bell, guest speaker; J. C. Woodward, Southern Bell, a member of the chapter's board of directors, and Col. Robert R. Creighton, Assistant Commandant, USASESCS, president of the chapter.

Introducing Mr. Mosley was Mr. J. C. Woodward, commercial manager of the Southern Bell Telephone Company in Augusta.

The chapter signed Col. Paul T. Snowden, Fort Gordon Post Commander, as a new AFCEA member, and greeted Anthony F. Barden of Augusta as its newest lifetime member. Mr. Barden is a civilian instructor at the Southeastern Signal School.

Both men were welcomed by Brig. Gen. David P. Gibbs, AFCEA National Council Member and Commander of the Army Signal Training Center, and Col. Robert R. Creighton, Chapter President.

Baltimore

Dr. S. W. Herwald, Vice President for Research, Westinghouse Electric Corporation, was guest speaker at the chapter's February 12th meeting.

Dr. Herwald, who recently spent two weeks in Russia as a member of a U. S. Mission on Automation, had an opportunity to observe the Russian scientists, economy, products and people. His talk, which was illustrated by photographs taken during the course of the mission, emphasized many of the little known facts and feelings in Russia.

Chicago — Motorola, Inc. was host to the chapter for its February 26th meeting. From left to right are: Arthur Schmitt, President of Amphenol Electronics and chapter vice president; Col. Paul W. Albert, Deputy Commander, U. S. Army Signal Research and Development Lab., principal speaker; Chapter President Henry J. McDonald, Kellogg Switchboard, and William S. Wheeler, Manager, Chicago Military Electronics Center, Motorola.

Chicago

Army communications of the future will utilize a four-wire basic, Col. Paul W. Albert, Deputy Commander of U. S. Army Signal Research and Development Laboratory, Ft. Monmouth, said recently.

Addressing the chapter, at a dinner meeting held at the Franklin Park plant of Motorola, Inc., on February 26th, Col. Albert called the proposed switchover to a Four-Wire Communication Basic "our most radical change" proposed for the Army of the future. Three hundred members and guests were present.

Separate transmitting and receiving pads will be provided through both the transmission and switching facilities throughout the entire communications system, from user-to-user, he said.

The Signal Corps Research Chief, guest of Motorola's Chicago Military Electronic Center, said that the need for the four-wire basic has arisen because of requirements for a material increase of communications circuits capable of handling high-speed data. A further reason is the large increase of radio circuits which will be required to provide secondary trunks and loop circuits to mobile users.

Dayton-Wright

Peter J. Schenk, an official of Raytheon Manufacturing Company, Waltham, Mass., addressed the joint meeting of the chapter and the Wright Memorial Squadron of the Air Force Association on March 19th. James Magill, president of the chapter, presided as Master of Ceremonies. Attendance was 175.

Mr. Schenk, who is president of the Air Force Association, warned the group that overemphasis on future weapons can be dangerous and called

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- **CREI Atomics.** Devised to meet the growing need for advanced home study education in Nuclear Engineering Technology for engineering and technical personnel in industry, government and military services.
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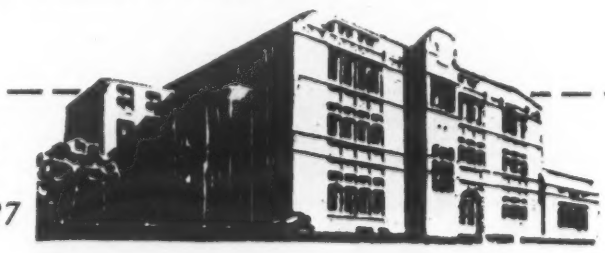

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for "an adequate security force in being" to preserve the free world.

"The next several years, our security will still be centered in aircraft," he said, "but this top priority item is getting lost." It is more economical, he said, to think wistfully of the future and casually label present weapons obsolete. "You can always do better down the road. But if the trend continues, we'll never have an adequate weapon force in being."

Mr. Schenk called for prudence in defense spending, but declared he felt more strongly about being a husband and father than about being a taxpayer. "I'm more worried about how well my family is protected than about how cheaply." And he said he thought that most Americans feel the same.

He ended by saying that "the American people, correctly informed and courageously led, have never failed to pay the price of freedom."

Guests were: Maj. Gen. and Mrs. V. R. Haugen, WADC; Brig. Gen. and Mrs. W. A. Davis, Hq. AMC; Brig. Gen. and Mrs. C. E. Jung, Commander, Dayton Air Force Depot; Dr. Jerome H. Meyer, Past Commander, and Morris Ribbler, Commander, Wright Memorial Squadron.

Decatur

A lecture demonstration on "Micro-Wave Magic" was featured at the chapter's March 31st meeting.

The program was conducted by Fred Wiedemann of the Illinois Bell Telephone Company. He was introduced to the group by Eldon Crown, also of Illinois Bell.

Fort Monmouth

The story of the world's most famous gems, with color illustrations of many fabulous stones and their owners, was presented by Mrs. Bradford Jahnes of the New Jersey Bell Telephone Company, at the March dinner-meeting of the chapter.

An exhibit of replicas of internationally famous gems, such as the Hope Diamond, was put on view in connection with the lecture, which followed a brief chapter business session.

Gulf Coast

Guest speaker at the March 16th meeting was George Senseney, supervisor of training for the General Electric Company at the newly constructed Air Force Ballistic Missile training site at Keesler Air Force Base. Mr. Senseney's talk was entitled "Fifteen Minutes to Live."

"They will have fifteen minutes to live," stated Mr. Senseney. "Air Force personnel manning the ICBM launching sites must be so well trained that they can start their huge guided missiles on the way to the enemy target within fifteen minutes after the warning bell rings. The enemy will most certainly fire his missiles at our launching sites, and if his aim is accurate, our launching site might be destroyed. Our airmen must get our missiles into the air before the enemy can damage our launching sites. They will be allowed fifteen minutes to do this, since the enemy missiles will arrive about twenty minutes after the warning signal."

"The General Electric Company, along with the Air Force and other companies, has spent thousands of man hours in planning and preparing a training program to meet this severe requirement. Literally hundreds of skilled personnel are required to man one ICBM Site. The General Electric Company has designed and built the ground guidance radar equipment the Atlas missile launching site, a they are now engaged in training first group of people to man the grou guidance system. Although training currently being conducted at the G eral Electric Plant in Syracuse, N York, operations will soon be tra ferred to the training site at Kees Air Force Base.

"The trained men will be sent to actual ICBM site, where they will ceive additional training, and parti pate in practice drills until they beco highly proficient in their particul jobs. From then on, the ICBM s must be kept in a state of readiness fire a missile in fifteen minutes. Th condition of readiness must be ma tained around the clock, week aft week, year in and year out."

Mr. Senseney discussed further d tails of the maintenance problems anti ipated in the situation previously d scribed, and told how their trainin program was arranged to solve the problems.

Dayton-Wright — Chapter President James J. Magill, center, has just presented a check $810 to Rodney J. Harrison, Director of Student Financial Aids and Scholarship at O State University, to be used as a three-year scholarship for an electronics engineering stud at Ohio State. Looking on is AFCEA Regional Vice President Paul H. Clark, who is chairn of the chapter's scholarship committee.

Kansas City

The chapter held its monthly dinn

Gulf Coast-Louisiana — Members of the Louisiana Chapter arrive at Biloxi for the recent joint meeting of the two chapters. In center, c left, William A. Gillentine, president of the Louisiana Chapter, is welcomed by Gulf Coast Chapter President Ancil Arseneau, prior to startin on a tour of the Keesler AFB Technical School. AF officer at far right is Capt. William R. Watkins, Keesler project officer for the tour and member of the Gulf Coast Chapter.

sented a check for holarship at Ohio ngineering student k, who is chairman

meeting at the Officers' Club, Richards-Gebaur Air Force Base, Grandview on February 26th.

Guest speaker was Capt. W. B. Goulett, Executive Vice President of AFCEA, who outlined the structure, goals, and purposes of the Association. He also reported on current AFCEA activities and reviewed plans for the annual Convention in June.

Fifty-eight members and guests were present. Special guest of the chapter was Col. L. C. Heartz, DCS, Communications and Electronics, CADF.

Louisiana

Television Station WWL was host to the chapter for its March 25th meeting. Dinner at La Ronde Restaurant preceded the program at the station.

Alan Sloane, WWL weathercaster, was the principal speaker and discussed "Weather and Man."

A tour of the WWL studio was conducted by Joe D. Bloom, Director of Engineering, who is treasurer of the chapter.

Montgomery

The chapter and the Montgomery sub-section of the American Institute of Electrical Engineers held a joint ladies night meeting at the Maxwell Air Force Base Officers Club on March 17th.

Cecil S. Stowe, Director of Public Relations, and Barrett Shiff, Chief Engineer of Quality Control of Orr Radio of Opelika, presented a program on stereophonic sound and also demonstrated the magnetic recording tape which is manufactured by their company.

London

The following item appeared in the local Headquarters Third Air Force Newspaper, *UK Eagle:*

"Admiral H. C. Bruton, Director of Communications and Electronics at U.S. European Command Headquarters in Paris, was guest speaker at the February 19th meeting of the London Chapter of AFCEA held at the Columbia Club.

"In a brisk but well-tailored address, Bruton explained to his colleagues the complexities of his command's foremost responsibilities of supplying NATO with a speedy and efficient communications system. He attributed this achievement to the teamwork of NATO nations on an unprecedented broad international scale.

" 'In spite of the complications in the establishment of compatible national radio operations,' he said, 'the willingness to work in harmony has permitted the successful intertwining of thousands of radio circuits required by the land, sea and air forces of the NATO commanders.'

" 'We are making every effort,' he said, 'to see that our military-owned communications are as modern as our resources permit, and are vigilant that they are operated in a manner compatible with the problems of the host country in the spirit of understanding and, with due regard to our mutual commitments and responsibilities to NATO.'

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"Bruton went on to praise the amateur radio fraternity that has developed internationally in the past few years. He said that with the many contacts made between amateur radio enthusiasts from many countries, it means the exchange of greetings and ideas with no barriers except those arbitrarily imposed by unsympathetic governments. The amateur radio is having a 'significant influence on the increasing use of the English language world-wide,' he said.

"From the technical standpoint in amateur radio, Bruton claims there is an experimental freedom from precedent, permitting new and unorthodox design and construction.

"The Admiral also expressed serious concern over the continued loss of manually keyed CW (transmission in code) operation which, he claims, is becoming a lost art with the advances in voice, teletype and data communications. 'Under extremely adverse conditions,' he said, 'manual telegraph is a priceless asset when all other means fail.'

"Bruton held high praise of British electronic products which, he said, show 'fine craftsmanship' and give 'excellent performance.' He also lauded the 'conciseness and clarity' of British electronic publications."

More than 100 members and guests were in attendance. Special guest of the chapter was Air Vice Marshal J. G. Elton, C.B., C.B.E., D.F.C., A.F.C.

North Carolina

The chapter held a dinner meeting on March 4th in the John R. Hodge Room of the Fort Bragg Officers Mess.

Col. Henry J. Hort, Chairman of the Nominating Committee, presented the following nominees who were elected to office for the coming year:

President—Col. Ray Bagley, 1st Logistical Command, Ft. Bragg; first vice president—W. Thomas Edwards, Southern Bell Telephone and Telegraph Company; second vice president—Thornton W. Rose, Carolina Telephone and Telegraph Company; secretary and treasurer—J. C. Coley, Carolina Tel. & Tel. Co.; national council member—James R. Fowler, Carolina Tel. & Tel. Co.

Thomas Edwards introduced Commander G. F. Moran, who is attached to the Navy Department in Washington, D. C., as the guest speaker for the evening. Commander Moran presented a program on the Polaris Missile.

Retiring President James R. Fowler expressed his appreciation to the membership for the interest shown during the past year.

London—Pictured at the chapter's February 19th meeting at the Columbia Club are, left to right: Capt. Henry Williams, Jr., USN, Chapter President; Rear Adm. H. C. Bruton, USN, Director C&E, Hq. USEUCOM, guest speaker; Air Vice Marshal J. G. Elton, and Mr. A. F. Cotton, Director CREI, London.

Northeastern University

The student chapter exhibited its solar telescope project at a recent "Conquest of Space" symposium for students presented by the Student Union at Northeastern University.

The symposium was open to the public and began with an address by Dr. Hugh Odishaw, Executive Director, U. S. National Committee for the International Geophysical Year.

The chapter's exhibit shared the floor with RCA, Smithsonian, GE and a host of other exhibitors.

Philadelphia

Over two hundred members and guests with security clearance attended a meeting which was classified confidential at the U. S. Signal Supply Agency on March 5th.

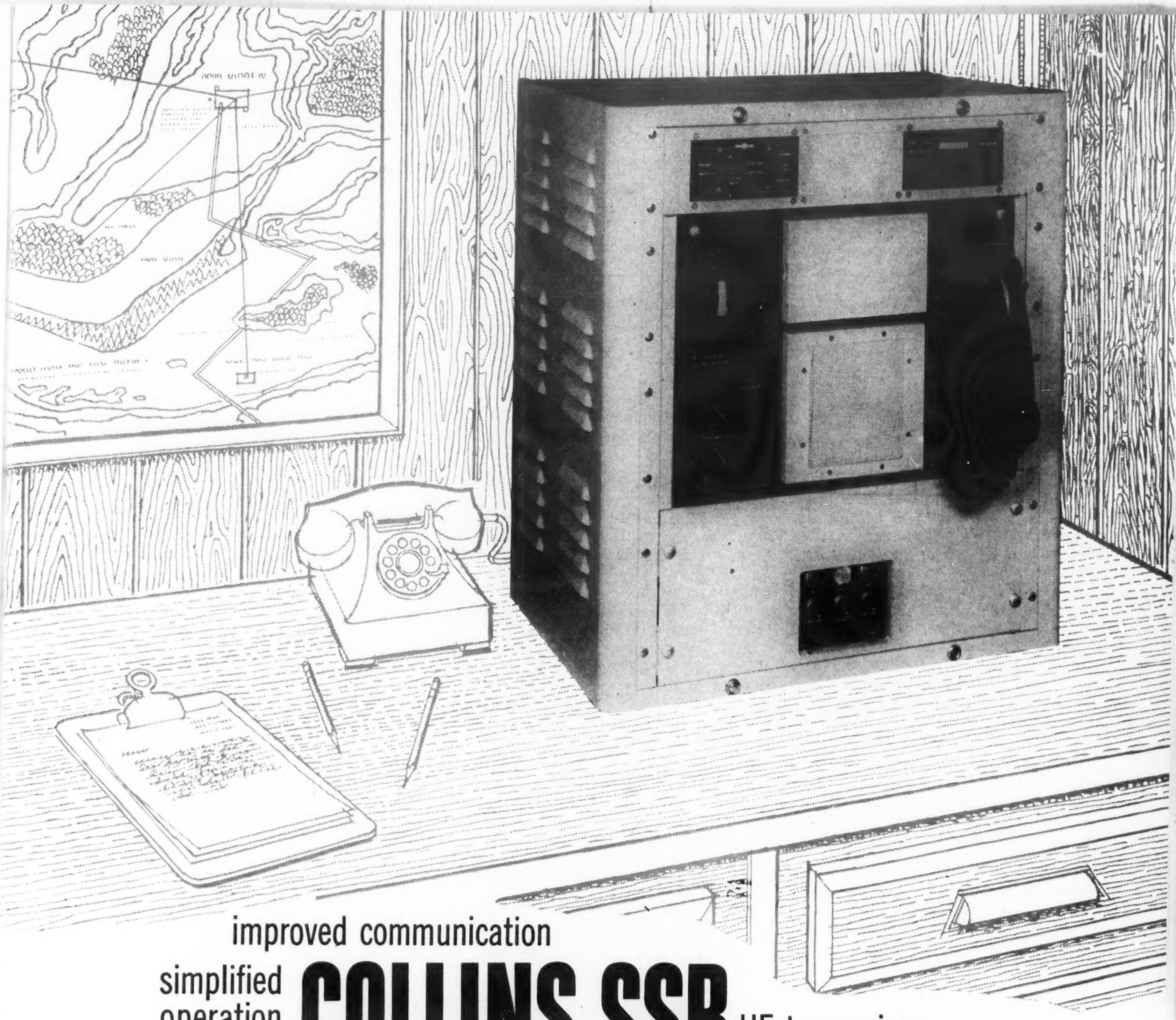
The following speakers from the U. S. Army Combat Surveillance Agency addressed the group: Brig. Gen. William M. Thames, Commanding General; Lt. Col. Norman Gray, Chief of the Sensory Devices Group; and Lt. Col. Willard D. Tiffany, Technical Operations Officer.

Pittsburgh

On February 4th chapter members attended a bicentennial science meeting sponsored by the American Institute of Electrical Engineers at the Mellon Institute.

Featured speaker was J. W. Simpson, Vice President of Westinghouse Electric Corporation and General Manager of the Bettis Atomic Power Division, whose topic was "Gateway to the Oceans and Beyond." Mr. Simpson, who has a world-wide reputation in the nuclear field, outlined Pittsburgh's claim to "Atomic Capitol of the World."

***Northeastern University**—Members of the AFCEA student chapter are shown explaining their exhibit of a solar telescope to some of the visitors at the "Conquest of Space" symposium sponsored by the NEU Student Union. The telescope, a special chapter project this year, was constructed from surplus military electronic material.*



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A special feature of the 32RS-1 is VOX control, with the transmitter actuated by the voice of the person speaking over the circuit. This makes it possible to operate the transceiver through telephone extensions or switchboards without extra push-to-talk switches.

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Ralph Will, Vice President of Hamburg Bros., Inc., and a past president of the chapter, was host to chapter members and guests at the company's plant on March 20th. Mr. T. J. Grady, District Sales Representative of RCA Victor, was the speaker. Special guest was AFCEA Regional Vice President Paul H. Clark of Dayton, Ohio.

The program included a complete demonstration of stereophonic sound. A second feature of the program was a demonstration and explanation of color television conducted by RCA experts.

Rome-Utica

The following account of the chapter's March 18th meeting appeared in the *Rome Daily Sentinel:*

"The history of radio aids to navigation since Lindbergh's flight across the Atlantic was outlined by Henri Busignies, president of ITT Laboratories, Nutley, N. J., last night at a joint dinner-meeting of military and civilian electronics engineers of the Rome-Utica area.

"The talk by the noted inventor was delivered in the VFW Home before the Rome-Utica Chapters of the Armed Forces Communications and Electronics Association and the Institute of Radio Engineers Professional Group on Communications Systems.

"Navigation components and systems described included the radio compass, medium and high frequency direction finders, radar, Loran wide-base very high and ultra high frequency systems and doppler and interferometer systems.

***Rome-Utica**—The March meeting was addressed by Henri Busignies, President of ITT Laboratories. Shown from left to right are: Brig. Gen. Haskell E. Neal, Commander Ground Electronics Engineering Agency, Griffiss AFB; Mr. Busignies; AFCEA Regional Vice President Glenn D. Montgomery of AT&T Long Lines, and Col. Daniel M. Harvey, Deputy Commander, Rome Air Development Center.*

"Also discussed were the air navigation system of Tacan, Vortac, distance measuring equipment-Tacan, instrument low approach and ground controlled approach.

"Busignies said that the International Telephone and Telegraph Laboratories have long been active in this field and have participated in the development of many of these systems.

"The speaker is the holder of more than 100 patents in nearly all areas of the broad electronics field. His inventions include the moving target indicator radar, which eliminates unwanted ground clutter on display scopes, and "Huff-Duff," the high frequency direction finding system which Hitler credited with turning the tide against his U-boat campaign in World War II.

"Glenn D. Montgomery, director of AFCEA for Region A (Northeastern), discussed the important work AFCEA is doing on a national, regional and local basis.

"Busignies was introduced by the chairman of the day, Col. Daniel M. Harvey, deputy commander of the Rome Air Development Center."

San Diego

The February 26th meeting was held in the modern Cypress Exchange of the Pacific Telephone and Telegraph Company in San Diego.

The program was especially arranged by Capt. Charles R. Clough, USMC Reserve, a chapter member, who is on the staff of the military department of the telephone company.

Members were shown the results of tests for propagation paths under all kinds of weather conditions for the developing 11,000 megacycle band. They also monitored all the local TV broadcast programs and studied the manner of handling and billing for direct dialing from San Diego to any other city.

San Francisco

General Electric's Vallecitos Atomic Laboratory in Sunol was host to the chapter on March 27th. Tours of the Laboratory were conducted in the afternoon after which the members and guests, numbering 111, attended a dinner-meeting at the Castlewood Country Club.

During the dinner-meeting, Mr. J. D. Adam of General Electric gave a brief talk and then showed a Pacific Gas and Electric film titled "License #1" which covered the history and construction of the Boiling Water Reactor. This reactor is being used by the Laboratory to obtain operational data for application to the design of the Dresden Nuclear Power Station reactor which GE is building near Chicago for the Commonwealth Edison Company and the Nuclear Power Group, Inc.

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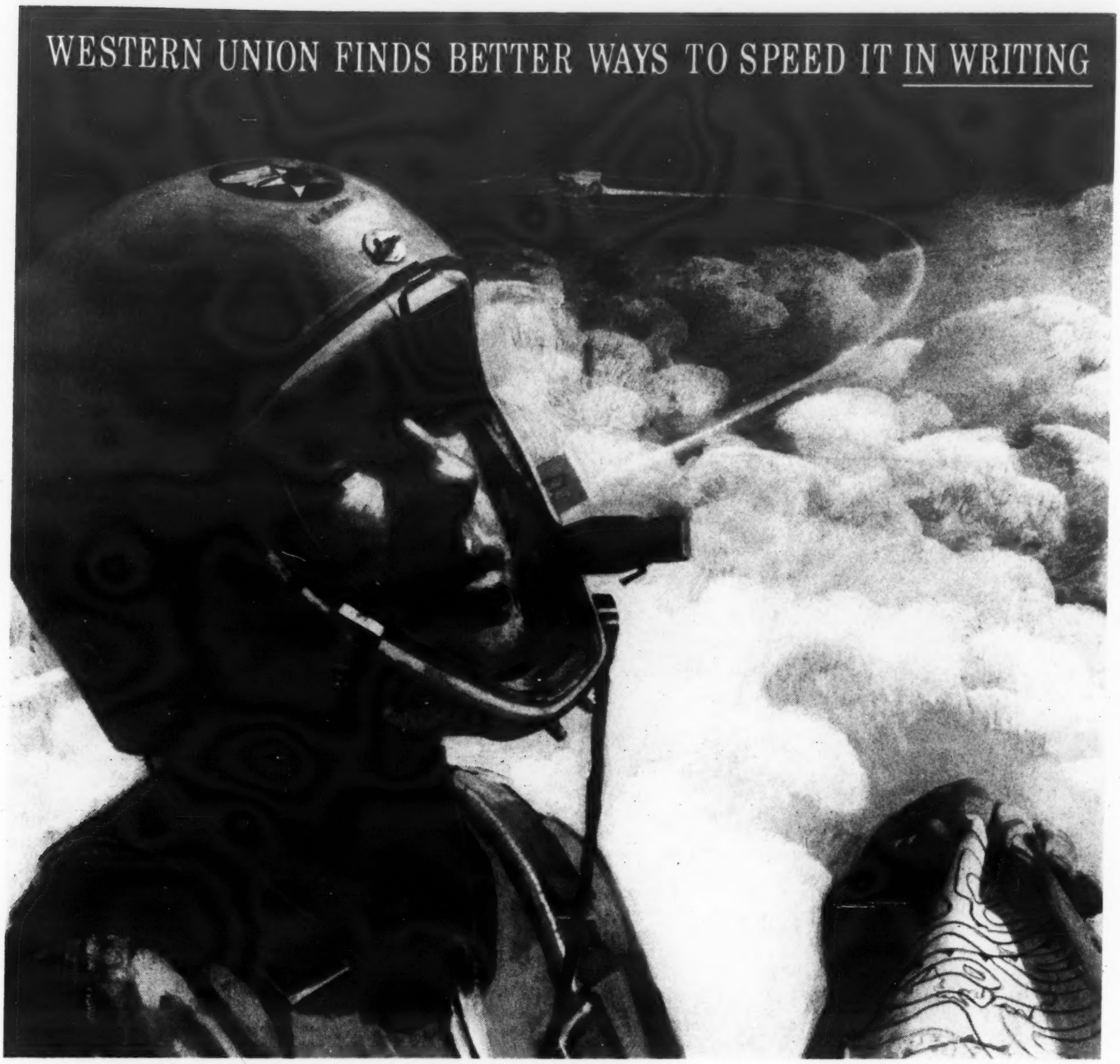

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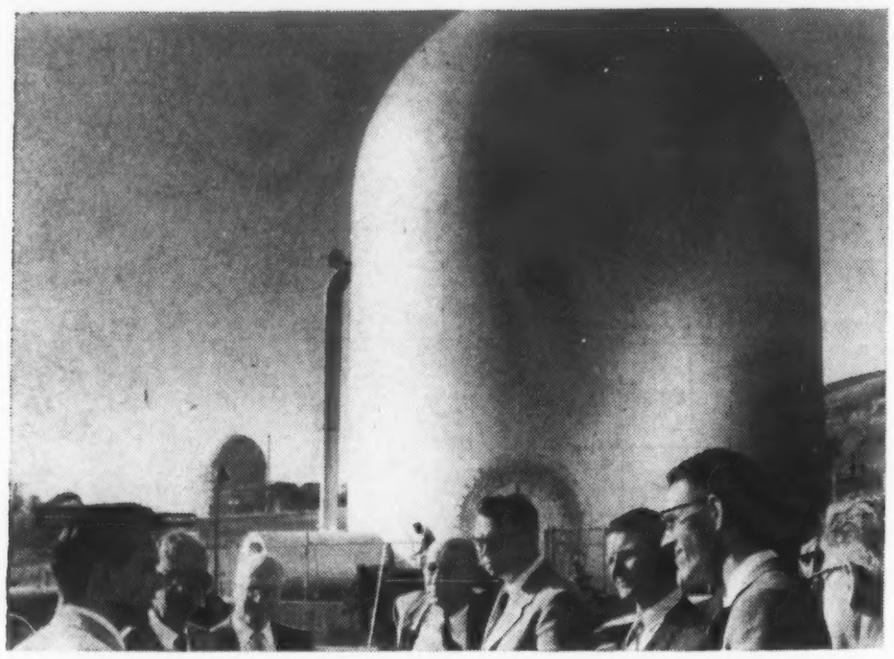

San Francisco — Chapter members toured General Electric's Vallecitos Atomic Laboratory in Sunol on March 27th. Shown in the background is the Boiling Water Power Reactor which is being described by a GE technician at the far left. Other points of interest visited were the Radioactive Materials Laboratory, the Experimental Physics Laboratory and the GE Test reactor.

est privately financed atomic research facility. The $14 million Laboratory is a component of the Company's Atomic Power Equipment Department at nearby San Jose, California, the organization responsible for the design, development, manufacture, and marketing of GE peacetime applications of atomic energy. The Laboratory supports the Department effort through basic and applied research in the nuclear field.

The tour covered the Radioactive Materials Laboratory, the Experimental Physics Laboratory, the Vallecitos Boiling Water Reactor and the General Electric Test Reactor.

The Vallecitos Boiling Water Reactor has the distinction of holding License #1 from the Atomic Energy Commission, the first authorization for a privately owned power reactor to be built in this country. The Pacific Gas and Electric Company owns and operates a turbine generator driven by the steam from the reactor and delivers 5,000 kilowatts into the Pacific Gas and Electric Company transmission system. This system is furnishing much information as an experimental installation for further development by General Electric.

The Radioactive Materials Laboratory conducts investigations on materials which have been subjected to nuclear irradiation, research in radio-chemistry, ceramics and metallurgy. The Test Reactor is used to perform developments on reactor fuels and components, general industrial testing, radioactive isotope production, neutron and gamma radiation research. The Experimental Physics Laboratory is used in the development of reactor control design, data on advanced core design and confirmation of design calculations.

Scott-St. Louis

"Communications for Defense" was the subject of a program conducted by James G. Barclay, Defense Communications Manager, Western Area, American Telephone and Telegraph Company, Kansas City, at the March 6th dinner meeting.

Mr. Barclay presented a comprehensive picture of the vast communications required for defense and the part played by the Bell System in contributing to the effective installation and operation of these communications systems.

Harry L. Cooper of AT&T, a director and former president of the chapter, introduced Mr. Barclay to the gathering which took place at Augustine's Restaurant in Belleville.

Seattle

George Shields of the Pacific Telephone and Telegraph Company presented a discussion and demonstration of the solar battery at the chapter's March 11th meeting.

The speaker stated that during the eleven years of intensive development of semiconductors, the Bell System developed an application of silicon applying the property that when bombarded with light rays silicon developed a direct current. The refinement of silicon has been a big problem; however, the Bell scientists have managed to purify it to a degree of one part in ten billion An e.m.f. per cell of 0.5 volts develops 0.35 volts across a load.

A demonstration was performed using a "solar battery" to operate a D. C. motor and other devices. An installation of such a battery is operating commercially in Georgia with an efficiency of 12% which compares quite favorably with motor-generators. The design efficiency of the "solar battery" is 26% which points up the relatively advanced state of the art.

A good future possibility for such an installation, Mr. Shields pointed out, would be in an area of considerable sunshine and where normal power facilities are out of the question. A question and answer period was conducted after the program.

South Texas

The February 26th meeting was held at the Randolph Air Force Base Officers Open Mess. Guest speaker was Leonard Blaylock, Special Agent in Charge of San Antonio Division of the Federal Bureau of Investigation, who spoke on "The Work of the F.B.I."

The following slate of officers was elected for the coming year: President —Maj. Gen. Harry Reichelderfer, USA (Ret.), Southwest Research Institute, who is also AFCEA Regional Vice President; vice presidents—Col. C. E. McBrayer, USAF; Col. Robert D. Easters, USAF; Lt. Col. Harry J. Wills, USAF, Oscar M. Screws, Western Union Telegraph Company; secretary —John D. Rainbolt, Southwestern Bell Telephone Company; treasurer—Wilburn Billington, Fourth U. S. Army Signal; board of directors—Maj. Gen. Gordon A. Blake, USAF, who is also a National Director of AFCEA; Col. W. D. Joslin, Fourth U. S. Army Signal, retiring president; S. J. Keane, Southwest Research Institute; J. W. Farley, Southwestern Bell Telephone Company; Branch Masterson, Hearst Advertising Service; Ralph Ness, Graybar Electric Company; Morris McGee, Western Union Telegraph Company, and Steve Simpson, Southwest Research Institute.

Tinker-Oklahoma City

On February 25th, approximately 300 people attended a joint meeting held in the Oklahoma City YMCA. The meeting included members of the Institute of Radio Engineers, American Institute of Electrical Engineers and the Tinker-Oklahoma City Chapter of AFCEA.

Dr. Hugh L. Donally, Assistant to the Manager for Technical Relations for RCA Laboratories, was the principal speaker. His subject "Electronics in Solids, Space and Sound" was presented with use of graphics and demonstration of electronics equipment. Electronics for space, devices that amplify light, and an electronic highway system were among the latest scientific developments that were discussed and demonstrated.

Dr. Donally's demonstration lecture also featured a four-pound portable transistorized television camera and an electronic cooling system with no moving parts. These are some of the recent achievements in research at RCA's David Sarnoff Research Center in Princeton, N. J. where a staff of more than 250 scientists and engineers is engaged in studies and developments ranging over the entire field of radio, television, acoustics and electronics.

Another important part of the talk was a discussion of the RCA Electronic Music synthesizer, an electronic system which can generate any tone produced by the human voice or musical instrument.

Special guests of the AFCEA chapter were ten high school students who had been awarded student memberships in the AFCEA by the chapter as the outstanding science or electronics students in the local high schools. These students are: Larry Wiggins, Capitol Hill Senior High; Jerry Burchfiel, Central High; Dick Fowler, Classen High; Melvin Combs, Douglass High; Jon Kent Law, U. S. Grant High; Larry L. Barnes, Harding High; Bruce Armour, John Marshall High; Harold Kirk, Northeast High; Rogers Stewart, Northwest Classen High, and David

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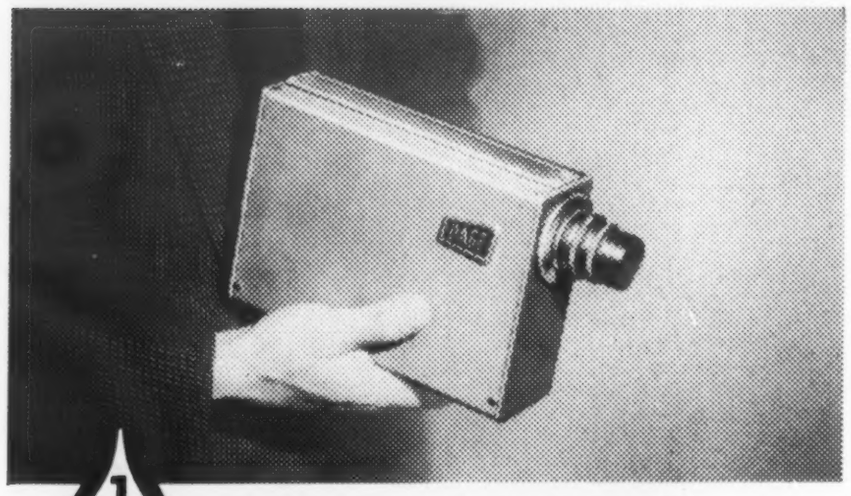

1

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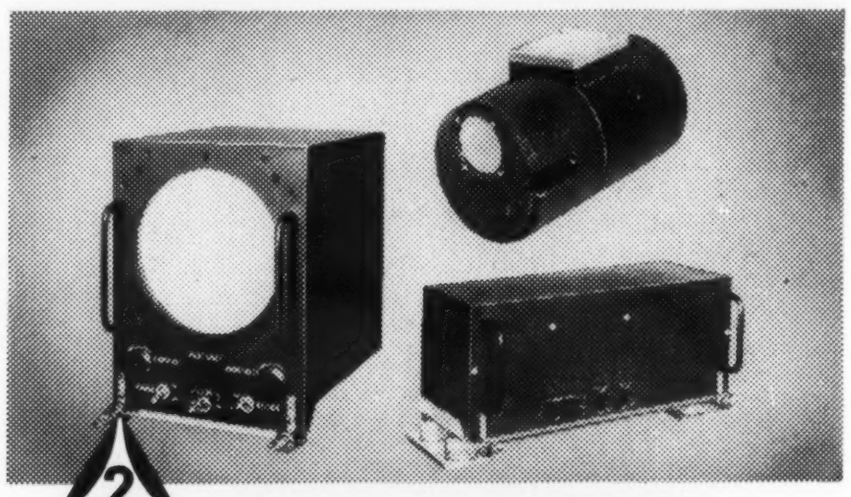
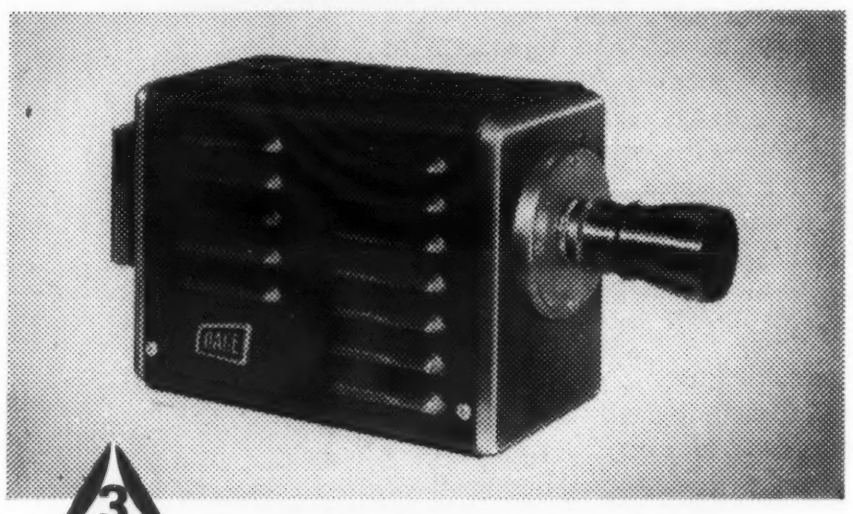
Weight: 4 pounds. Size: 2⅜" x 5⅜" x 7¾". Output: EIA composite video. Operating Controls: None, except on-off. Completely automatic, with self-contained EIA sync. 600 line resolution.



2

AIRBORNE TRANSISTORIZED TELEVISION SYSTEM — Model MTS-4

Camera, Camera Control and Monitor. Qualified to MIL-E-5272B; MIL-E-5400; MIL-I-6181B.



3

COMPLETELY SELF-CONTAINED INDUSTRIAL CAMERA — Model 63A

Automatic beam, target and electrical focus.

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Michigan City, Indiana

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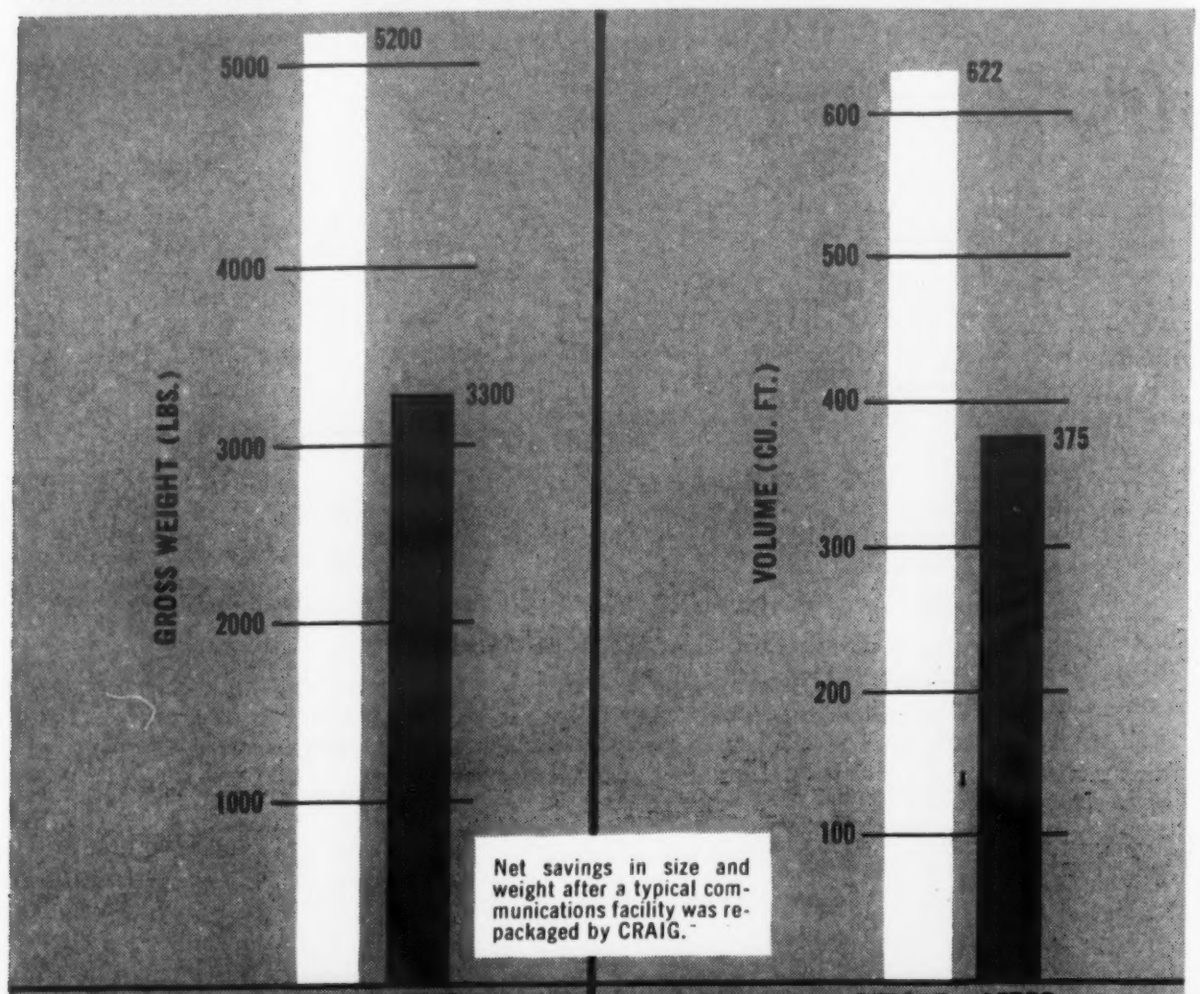

37% Savings in weight

40% Savings in size

when this typical system was repackaged by Craig !

Recently, Craig was asked to study a 'mobile' military facility, and repackage it. The result: 1900 pounds of unnecessary weight, eliminated. 246 cubic feet of unnecessary space, eliminated — the existing components repackaged in a modern, lightweight, high-strength Helicop-Hut® shelter – efficiency increased, handling and transportation made easier, faster, safer — time and money saved.

Can you profit from this example? It's worth remembering that Craig not only repackages existing components and checks out the complete system for electrical continuity — but also, where necessary, modifies, modernizes, or replaces outdated equipment for maximum efficiency. If you have any problem at all in systems packaging, contact a Craig packaging specialist today.

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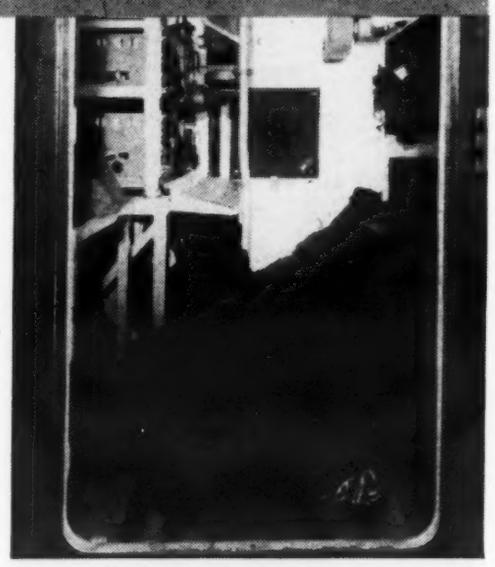
Tel.: MUrdock 8-6961

Los Angeles 45, California, 6214 W. Manchester Ave.
SPring 6-0025

Haddonfield, New Jersey, 1016 Berlin Road
HAzel 8-2400

Washington, D. C., The LaSalle, Suite 815
1028 Connecticut Ave., N.W., DIstrict 7-1575



After repackaging by Craig engineers in highly mobile Helicop-Hut, total weight has been reduced by 1900 pounds, total space has been reduced by 246 cubic feet. Antennas are packaged and tied down to floor for transit.

Systems have a lot more get-up-and-go when they're packaged in CRAIG Helicop-Huts!

Clark, Southeast High.

Washington

Maj. Gen. James Drefus, Director for Communications-Electronics, Joint Chiefs of Staff, spoke on "Management and Control of Military Communications" at the March 5th luncheon meeting at the Willard Hotel. His speech was reported in the feature section of the April issue of SIGNAL.

A new attendance record of more than 825 members and guests of the Washington Chapter paid homage to the retiring Chief Signal Officer, Lieutenant General J. D. O'Connell at the April 2nd meeting in the Willard Hotel.

Principal speaker was Dr. William H. Martin, Army Director of Research & Development, who discussed "The Communicator's Heritage," tracing the significant accomplishments of communicators during recent historic years of electronics progress. In particular, he emphasized the close technical liaison between the military and industry.

"For ninety-nine years," said Dr. Martin, "the U. S. Army Signal Corps has had the mission for advancing the art and science of communications. While its interests have been primarily for military purposes, we are all well aware today that military and civilian interests, particularly in this field of technology, are so intertwined that it is difficult to separate them."

During the course of the meeting, General O'Connell was presented with a scroll of appreciation from General Omar Bradley, and with an AFCEA service pin by Chapter President John O'Brien. Also participating in the special program honoring the retiring Chief Signal Officer was the Army Chorus from Fort Myer, Virginia.

Seated at the head table during the impressive ceremony were: Chaplain (Lt. Col.) Joseph S. Chmielewski, Chief of Chaplains for the Military District of Washington; Lt. Colonel George J. McNally, Commanding Officer, White House Army Signal Agency; Dr. C. M. Crenshaw, Chief Scientist, Research and Development Division, Office of the Chief Signal Officer; Brigadier General A. F. Cassevant, Commanding General, Fort Monmouth, New Jersey; General of the Army Omar N. Bradley, Chairman of the Board, Bulova Watch Company; Lieutenant General J. D. O'Connell, Army Chief Signal Officer; Major General William P. Corderman, President of Times Facsimile; Reverend Richard Irvin, Pastor of North Bethesda Methodist Church; Colonel M. D. Brown, Commanding Officer, U.S. Army Signal Research and Development Laboratory, Fort Monmouth, New Jersey; Major General H. L. Schofield, Chief, Procurement and Distribution Division, Office of the Chief Signal Officer; James M. Bridges, Director of Electronics, Office of the Assistant Secretary of Defense (R&E); Brigadier General Earle F. Cook, Chief, Research and Development Division, Office of the Chief Signal Officer; Dr. Martin, and Chapter President O'Brien.

What You Should Know About This Symbol...

It may be new to you now, but you'll see it again and again. It's a symbol of service to government, the armed forces, to defense industry.

For it represents The Singer Manufacturing Company's *Military Products Division*, a functional team of three well known organizations—Haller, Raymond & Brown, Inc., Diehl Manufacturing Company, and Singer-Bridgeport.

The Military Products Division provides scientists and engineers familiar with government requirements . . . development and production facilities for making systems, products, and components in large quantities, at a practical cost.

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ITEMS OF INTEREST

From Government, Industry and the Services

Radar Drives Car

Two Westinghouse Electric Corporation engineers have produced a radar device which, they say, can make all the driving decisions for motorists of the future.

Dr. Yaohan Chu and P. N. Buford, of the Westinghouse electronics division at Baltimore, predicted the program will be in experimental use in two years and may be in general use within five years.

Automobiles could follow a strip of foil or special paint down highways while all control functions—including steering, determination of speed and stopping—could be handled automatically, they said.

"This radar system could give a panoramic display of the roadway ahead for a distance of up to one mile and would be effective for day or night driving in any type of weather in which cars could travel with reasonable safety," Mr. Buford explained. It could indicate the distance to other automobiles, the closing rate and give a collision signal if such a situation appears possible.

"Another important potential is the capability of reading code guidance signals from the foil or paint strip on the road," Dr. Chu added. "This will make it feasible to program coast-to-coast driving with speeds predetermined according to the safety conditions of the road."

The inventors calculate a complete system for one car could be mass produced for about $250. It would weigh only 40 pounds and would fit either under the hood or behind the grill of an average-sized automobile. The only visible component would be the radar antenna mounted in the center of the grill.

The inception of the large-scale federal road building program involving construction of many miles of super highways in the next few years makes the guidance program even more pertinent, the radar specialists pointed out.

However, the system is compatible with existing roads because no major work would be needed to add the guidance lines that radar would track. The material to reflect radar energy back to the automobile could be installed either in the form of adhesive-backed metal foil or a metallic paint that could be sprayed on the road with the same equipment that now sprays center lines and lane markers.

When signals are reflected by the metallic guidance strip back to the antenna, they would be fed through electronic devices which would sense the degree of error in steering and call for corrections that would be automatically directed to the car's power steering mechanism.

"But even with the system in operation, the driver will be able to assume complete manual control simply by turning the steering wheel," they added.

Slowing, stopping and speed control decisions could be made automatic across the country by a uniform system of code symbols which the radar system would recognize. These symbols could take the form of smaller, paralleled areas of the guidance strip.

Army Inventor

Lt. Col. Ollie J. Allen of the Army's Southeastern Signal School, Fort Gordon, Ga., has invented a device which he calls the "Electronic Trainer for Switchboard Operators."

Consisting mainly of a tape recorder, a home-made continuous tape track and several time-switch devices, the new machine can keep three switchboard operators busy by placing calls through 40 different telephone lines.

The "trainer"—now being field-tested by student operators at Fort Gordon—calls central, waits until the operator answers, asks for a number (by tape recording), gives the operator 12 seconds to place the call, then rings itself off and scores the operator.

The machine goes through this procedure about 16 times a minute, rotating four lines at a time. This adds up to 960 calls an hour—all automatic, with no attendant needed.

Col. Allen, chief of the Southeastern Signal School's Radio Communications Department, took only six weeks to design and build the trainer. An earlier attempt had been made by industry to perfect a machine for the same job but the cost, about $5000 per machine, was prohibitive.

Col. Allen's invention cut cost of the product by 90 percent. The inventor estimates his machine "could easily be built for $500."

Other Allen inventions, all of which are now being used or developed by the Army, include: the "Allen Sight," an electronic gunsight for night firing; radio transmitter and receiver AN/GRC-9, now standard in the Army and Navy; a radio relay now being used on the Army's AN/GRC-3 radio; radio-telephone relay AN/GSA-7, another standard piece of military communications equipment; an electronic anti-tank mine; an acoustic television camera tube; an ultrasonic communications system; an ultrasonic ear plug; an ultra-sensitive infrared light detector; an automatic power voltage regulator; a stable electronic tone generator; a means for integrating radio and telephone communications systems; a mechanical cipher device, and a high-level modulation system for radio transmitters.

Device Computes Astronomic Position

Disclosure has been made of an electronic surveyor and star gazer that can quickly determine the astronomic position of any point on earth to within a mere ten feet.

By reducing the uncertainties as to the precise locations of the launching site and other points along a flight path, the new device will enable more accurate guidance of long-range missiles.

Astronomic position is determined by a computer working hand in hand with an optical star-observing instrument. The computer trains the star gazer in the anticipated direction of a known star. When the earth's rotation causes the star to enter the field of vision of the star gazer—otherwise known as a pendulum astrolabe—a photoelectric device signals the computer. The computer instantly notes the exact time by means of an electronic clock, checks the position of the star gazer with the help of a gyro compass, and then, after a suitable number of stars has been similarly observed, computes the location of the observation site to within one-tenth of a second of arc, or about 10 feet.

The device was described by F. J. Alterman of the Mechanical Division of General Mills, Inc. at the 1959 IRE Convention.

This project, the design, development and installation of an operational anti-jam communications system—the first to use an astronomical body as a passive relay station—was undertaken by us just 36 months ago. Described by Rear Admiral Rawson Bennett, Chief of Naval Research, as "one of the most significant advances in radio communications in many years," Communications Moon Relay is designed to link Washington and Pearl Harbor by way of the moon.

In addition to providing communications that are virtually jamproof against either enemy or nature, Communications Moon Relay opens up a whole new spectrum of radio frequencies for long range communication.

A system such as this Moon Relay—designed, developed and installed by us for the U. S. Navy—is the type for which our experience and our creative and imaginative approach to challenging communications problems are particularly suited.

It is just one of the many "out of this world" problems we have solved, or are now solving, for the military services and other Government agencies with exacting communications requirements.

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Air Reserve Records

Complete historical records of a half-million Air Force reserve officers and airmen are maintained at the Air Reserve Records Center in Denver and it is from here that a ready reserve must be brought to quick mobilization in time of emergency. This can be done only by maintaining the ARRC's growing records efficiently and properly.

The roughly quarter of a million Air Force reservists of four years ago have more than doubled. In 1959, the growth is expected to level off at about 600,000.

Results of this expansion imposed management control problems. Several years ago, when all reserve records were moved from eight locations throughout the country to Denver, it was necessary to place all records under a single method since eight different methods were used to maintain the reserve records.

Storage became a problem at the beginning of 1958 when the records occupied approximately 3200 four-and-five-drawer steel file cabinets and some 30,000 square feet of floor space. Projected estimates indicated the future records would require 800 additional file cabinets at a cost of about $40,000 but more floor space was not available.

Under contract, Remington Rand sent in a survey team to make recommendations pertaining to the space problem, increased general efficiency and savings in the operation. As a result of its study, the team, composed of Remington Rand, Air Force and ARRC personnel, recommended the records be converted from file cabinets to open shelf filing and a terminal digit sequence replace an alphabetical sequence.

After almost a year under the new system, the Center reports increased efficiency and expects shortly to achieve an annual saving of approximately 30,000 man-hours which is an annual wage savings of about $60,000.

Used floor space has been cut from 30,000 to 18,000 square feet and there is room for the maximum 600,000 records expected.

The final major change was to convert from the drop card system to drop folders. This eliminated the posting operation on almost all charge-outs, and kept a folder available for filing papers received while the record is out of the file. Estimated saving here runs to almost 9000 man-hours a year.

The biggest job is maintaining a current address on reservists. Over 26,000 move to new addresses every month and, if the Center is not informed, time consuming methods must be employed to contact them.

Records must be complete, of course, for sudden mobilization. An equally important reason from the standpoint of the reservist himself is a financial one. One of the ARRC's jobs is to figure and keep an accurate count of points toward retirement.

Under Titles 10 and 32 of the U.S. Code, an officer's selection folder must have correct data for him to even be considered. If the reservist fails to report pertinent status change or there is an error or discrepancy in the data, it could mean not only a lost promotion but lost retirement pay.

Maximum benefits of the new system, judging from a check with organizations already using it, can be as follows: (1) 38.8 percent faster filing; (2) 39.4 percent faster finding; (3) unlimited, equal expansion throughout the file, (4) elimination of name similarity within the file; (5) simple, consistent guiding arrangement, and (6) substantial savings in floor space already mentioned.

Two years ago, the ARRC had about 1200 people administering approximately 250,000 records and they now have the same number handling a doubled amount.

Indications are that when they attain the 600,000 point, they will be doing the total job with about 1000 employees.

Air Force MARS Net

The June schedule for the Air Force MARS Western Technical Net, to be heard on Sundays, 2-4 PST on 7832.5 kcs, 3295 kcs and 143.46 mcs., will include:

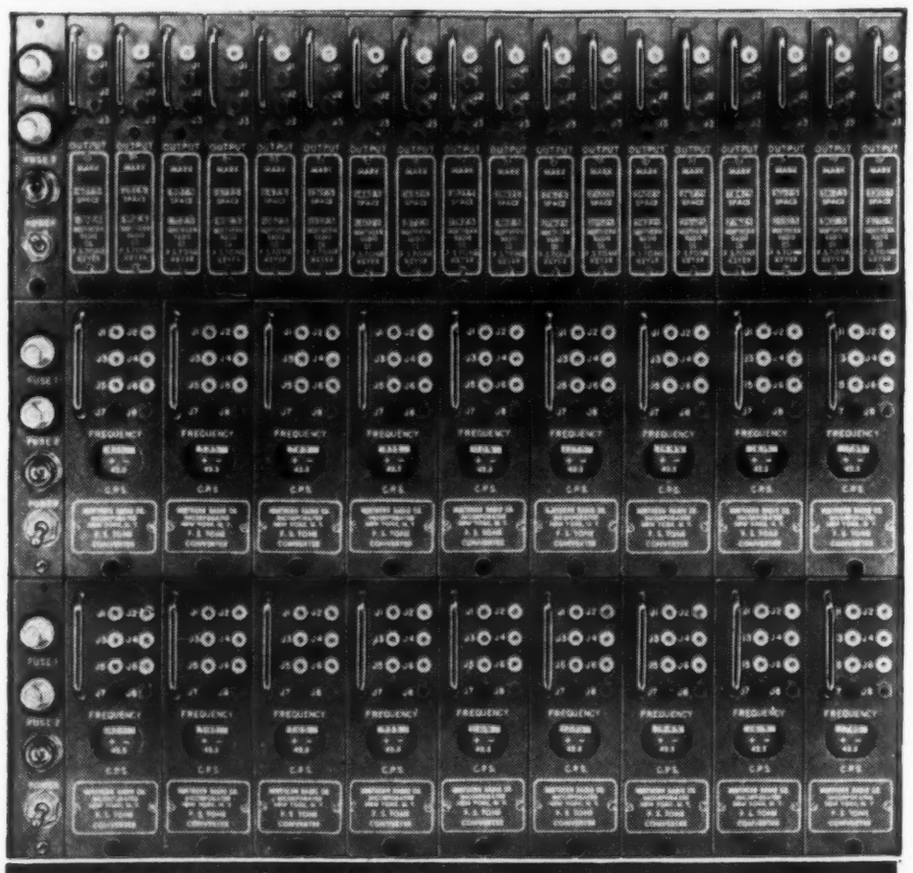
June 7: "Air-Ground Communications on Historical Long Range Flights" by Col. Frank Shannon, USAF (Ret.), Manager, Technical Field Service, Packard Bell Electronics.

June 14: "Storage of Intelligence: Sight and Sound" by Jim Stultz, Administrative Sales Manager, Ampex Corporation.

June 21: "The Space Age and California" by Charles F. Horne, Vice President and Division Manager, Convair.

June 28: "Equipment Utilization and Conversion Information" by USAF MARS Western Technical Net Members.

The AF MARS Net will not broadcast during July and August and scheduled broadcasts will resume September 6.



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How Far Will a Baseball Curve?

Scientific experiments show that the maximum curve a baseball pitcher can expect to throw is about 17 inches. The most effective speed is about 100 feet per second, which is well within the capacity of a professional pitcher.

Speed by itself, however, has little effect. The important factor is the amount of spin. The maximum curve of 17 inches is reached at 1800 revolutions per minute, which a professional can at least approach.

Conclusions have been announced by Dr. Lyman J. Briggs, Director Emeritus of the National Bureau of Standards and Director of Research for the National Geographic Society, of the experiments which are of value in aerodynamics.

The serious purpose of the study is to determine the relationship of spin to deflection at different speeds. This problem has application to ballistics at very low speeds.

Dr. Briggs' research was conducted in NBS laboratories when the equipment was not needed for the Bureau's work and at Griffith Stadium where he received the cooperation of members of the Washington Senators.

Electronic "Editing"

Since the transmission of large quantities of raw data about animals or humans in a satellite is considered impractical by Miles A. Mc Lennan of the Aero Medical Laboratory, Wright Air Development Center, he proposes an electronic system which would "edit" the information.

To reduce equipment weight to a practical level, it will be necessary for an "electronic reporter" to remove unimportant information from the data to be sent to earth.

Mr. Mc Lennan proposed that decision and logic circuits, similar to those found in electronic computers, be used to decide whether or not a signal is newsworthy enough to be transmitted. To save power the newsworthy signals would be temporarily stored and transmitted only upon demand by radio from the ground.

Also suggested was an "animation index" to be used to boil down the amount of information that needs to be sent. The animation index would provide seven ways of describing the passenger's state of animation ranging from "optima" to "dead." Decision and logic circuits would determine which of the seven states best described the passenger.

A second, less reliable data system would also be used as an accessory or "fill in" system. Television voice communication and certain non-vital classes of physical and physiological data would be handled by this system. The dependability of contact with ground would be marginal due to the use of minimum transmitter power for the second system.

Mr. Mc Lennan noted that an equatorial orbit would be highly preferable for a passenger-carrying satellite experiment, both from the data system standpoint and that of vehicular recovery, because an equatorial route minimizes the number of necessary ground stations as well as the tracking and searching area. A second preference, he said, might be the 90 degree or polar orbit, where the ground stations could be grouped near the North or South Pole.

GE Robot

"Handyman," a feeling, hearing robot able to clutch its hands like a human was unveiled recently by General Electric Co.

According to the company, the robot, developed to support production of an atomic aircraft, will be able to work in radioactive areas where a man could not survive.

Outside of the danger area, the operator of the device will be able to feel everything the robot does and hear what it hears from the inside of a master unit harness.

GE added that the robot can be directed to accurately hammer a nail, unscrew a bolt or twirl a hula hoop.

Although its strength is said to far exceed that of man, the touch is deft enough to pluck petals from a daisy.

The master unit can dictate an almost infinite range of movement since each hand and arm of the robot has 10 basic motions.

Job Automation

According to William V. Baker of National Electronics Executives Exchange, automation has arrived for engineers and executives seeking new positions in the electronics and missile systems fields. Mr. Baker said that his firm has classified over 8000 electronics and missile firms on cards according to their special fields.

Job-seekers submit their confidential résumé and the information is condensed and coded by numbers since no applicant's name or affiliation is revealed. This confidential résumé summary is then sent to the companies in each man's specialized field.

Preview the new **WESTREX AERO-MONATEL**

Westrex presents its lightweight, compact Aero-Monatel frequency shift radio receiver and printer combination.

- **4 Fixed Frequency Channels**
- **Total Weight 28 lbs. (including printer)**
- **Speeds to 100 w. p. m.**
- **Only 2 External Connections (power and antenna)**
- **Single Knob Frequency Selection Control**

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Language for Machine

A mechanical brain that will supervise the work of other machines by the use of a 107-word language, has recently been developed as a result of the combined efforts of MIT, the Air Force and the Aircraft Industries Association. Regarded as a significant advance, the electronic system, called APT (Automatically Programmed Tools) will aid in the rapid production of airplane and missile parts.

According to an Air Force official, use of the system will enable the United States to build better airplanes and space missiles at no increase in cost, as well as a "war machine that nobody would want to tackle."

The language is based on a simplification of English words in which "rgt" means right and "lft" means left. The language can be used by a technician to make a machine understand what he wants it to do. After taking the simple directions, the machine figures out how another machine will do the work. The brain could also use APT to produce a scaled-down or enlarged version of any machine or tool. Engineers should also be able to cut down the time lag between an airplane's birth on a drawing board and its completion.

Russian Visit

Six American electronics specialists returned last month from a three-week visit to Russia.

Official guests of the State Committee for Radio Electronics of the Council of Ministers in Russia, the group toured Russian electronics laboratories and plants. The reciprocal trip was similar to a visit made by a Soviet electronic delegation to the U.S. last November. The Electronics Industries Association was host to the Russian group.

Ray C. Ellis, Vice President of Raytheon Manufacturing Co. and Chairman of the International Division of EIA, headed the American delegation.

Other members were: Frank W. Mansfield, Chairman of the Marketing Data Policy Committee, EIA, and Director of Marketing Research, General Radio and Electronics Co., New York; Julian K. Sprague, President, Sprague Electric Co., North Adams, Mass.

Also, Dr. Conrad H. Zierdt, Jr., General Electric Co., Syracuse, N. Y.; Dr. Imre Molnar, General Telephone Laboratories, Northlake, Ill.; Charles P. Marsden, Jr., Chief of the Electron Devices Sections, National Bureau of Standards, Washington, D. C.

Names in the News

Frederick R. Furth, President of AFCEA and Vice President in Charge of Research and Development of ITT, recently returned from a month's tour of the ITT research facilities in Europe. While in Europe, he addressed the London AFCEA chapter and conferred with officers of the Paris chapter.

Paul Goldsborough retired at the end of March as Director of Telecommunications Policy in the Office of the Assistant Secretary of Defense for Supply & Logistics. He will be succeeded by **William Hatton**, retired ITT Corp. official.

John H. Titley has been named Sales Manager for the Defense and Technical Products Division of Rheem Manufacturing Company. Mr. Titley will head up a new alignment of the division's marketing department.

Jack F. Lepre has been named by Dynamics Corporation of America to the newly-created post of Vice President in Charge of Industrial Relations and Special Projects for its wholly-owned subsidiary, Reeves Instrument Corporation.

Hugh A. Young has been appointed as West Coast Technical Marketing Consultant for The Hallicrafters Co. He resigned recently from Packard-Bell Electronics Corp., where he was Sales Manager of the Technical Products Division.

Arthur W. Sigmund, Vice President of Kraft Foods Company, has been designated as a member of the Executive Reserve of the Office of the Secretary of Defense. He will serve in the office of Murray Snyder, Assistant Secretary of Defense for Public Affairs. Mr. Sigmund is assigned to the Industrial Services area of the Office of Public Services for an indefinite period.

Capt. Robert A. Weeks, USN, has succeeded **Capt. W. A. Ellis** as Assistant Director, Naval Communications.

AFCEA members are pleased to note that **Lt. Col. Kenneth E. Shiflet, SigC.**, has recovered from a recent operation.

A. William Christopher, Jr., Sylvania Electric Products, Inc., succeeds **John O'Brien**, Hoffman Laboratories, Inc., as President of the Washington AFCEA Chapter. Mr. O'Brien is to be congratulated for his splendid work in arranging the farewell luncheon for General James D. O'Connell. Gen. O'Connell was presented a plaque on behalf of AFCEA by General Omar Bradley at the April 2 chapter meeting.

RAYTHEON SPARROW III

New Navy missile, now with Fleet, guides itself, out-thinks target.

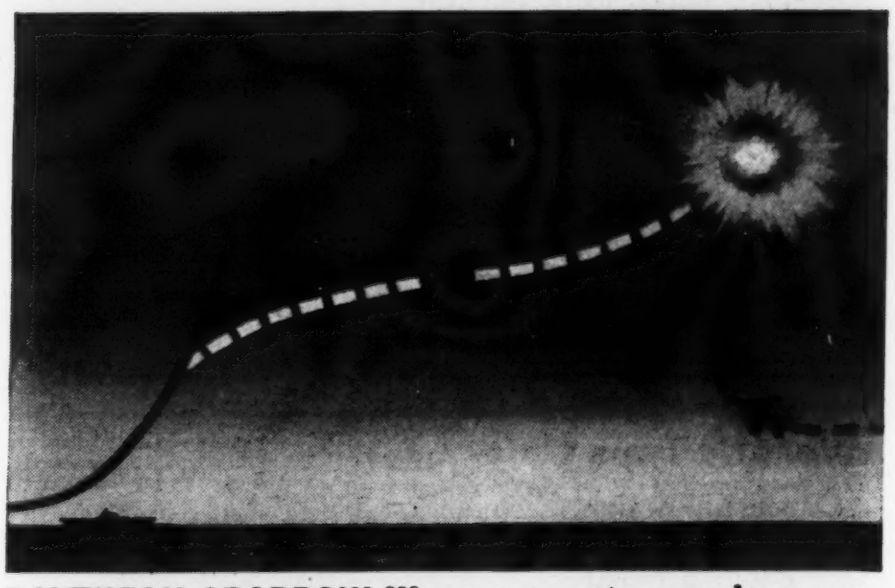
Sparrow III is tenacious, accurate, lightning-fast. It uses a unique "wide-angle" radar target seeker which permits Navy pilots to launch missile from almost any approach angle and still score a hit. Once locked on target, Sparrow III guides itself, flying at several times the speed of sound, and unerringly intercepts the hostile aircraft despite evasive action.

Now operational aboard Navy carriers, Sparrow III is slated for fighter squadrons throughout the Fleet. The missile is designed and produced for extreme reliability; has a powerful warhead and all-weather capability.

Raytheon is prime contractor for the Sparrow III, under the Navy's Bureau of Aeronautics. This new missile is another example of how the 39,000 men and women of Raytheon are contributing to national security.

RAYTHEON MANUFACTURING COMPANY,
Waltham, Mass.

Excellence RAYTHEON *in Electronics*



RAYTHEON SPARROW III weapon system employs new "wide-angle" radar. Navy pilot can launch missile from almost any angle and hit the target. Missile guides itself automatically, relentlessly destroys enemy aircraft in spite of evasive tactics.

NOW BEING DELIVERED to the Fleet, Sparrow III arms the latest Navy jet fighters. This new 12-ft. long, 8 inch diameter missile is rocket powered, highly reliable, has all-weather capability. It is extremely accurate and carries a powerful warhead.

NEW PRODUCTS FROM INDUSTRY

Anti-Magnetic Housing for CC TV

A new device, designed to protect TV cameras against interference from magnetic fields produced by high AC or DC currents, has recently been announced by the General Electric Company of Syracuse, New York. Reported to be first of its kind, the anti-magnetic housing for closed circuit television cameras is expected to find widespread use in industrial applications. Such applications include observation of metallurgical furnaces or wherever camera operation would be affected by high-capacity power lines.

The device is 11½" in diameter, 21" in length and weighs 33 pounds. The housing is made up of three layers of special metals. A combination of two metals provides protection against AC fields, while the other two metals combined provide protection against DC. Protection is assured against 40 gausses in a DC field and 80 in an AC field.

The device was designed primarily for GE's industrial TV camera models TG-2 and TE-6, but will accommodate many other industrial cameras.

Improved Computer System With New Magnetic Tape Unit

A specially designed magnetic tape unit that eliminates the need for separate data acquisition, conversion, translation and processing equipment, is now available from Thompson Ramo Wooldridge Inc., Los Angeles. The combination of the RW-300 Digital Control Computer and a matched magnetic tape unit creates a powerful on-line data reduction system which is ideally suited for many applications in test facilities, and which costs less than arrays of individual equipment required to accomplish comparable tasks. The system makes available at the test site complete computational abilities, as well as data collection, conversion and logging features.

The magnetic tape unit consists of from one to eight tape transports coupled to the computer through a magnetic core buffer. Each transport has a storage capacity of up to 1.3 million computer words of 18 bits each. During operation in a test facility, the system can collect and record data at a maximum rate of 2,560 words per second.

Answers, tabulations and other information can be printed out on automatic typewriters, punched out in paper tape and cards, and/or displayed on XY plotters, making it possible for current records to be produced along with data in convenient form for further study and analysis. Reduction in real time may be achieved in many cases by the simultaneous occurrence of test operation and data analysis.

The tape unit was designed to achieve maximum reliability of operation by the utilization of parity checking, error surveillance, derated electronic circuitry and highest quality components.

Ultrasonic Short-Long Delay Lines

Development of ultrasonic delay lines with very short and extremely long delay times, which will store a signal with minimum attenuation for periods ranging from less than 50 to more than 15,000 microseconds, has recently been announced. They are produced by Corning Glass Works of Corning, New York for military radar systems.

Ultra-short delay lines were developed through glass composition research. The glasses have close to a zero temperature coefficient of time delay and can provide delay times up to several hundred microseconds without the need for bulky and heavy heating equipment. Manufactured with the same techniques as those for optical glass, the new glasses can thus be formed into standard glass shapes.

The ultra-long delay lines were developed through improvements in fused silica production methods, which make it possible to form plates of pure fused silica up to 48" in diameter. The extremely low acoustic attenuation of fused silica makes possible delay times of 15,000 microseconds in a single plane delay line.

Transistor Tester-Sorter

A new electronic machine has been developed which can detect the intrinsic qualities of up to 1200 different levels of performance in transistors, according to Raytheon Manufacturing Company's Semiconductor Division, developer of the new device. The machine can also automatically select and sort these microminiature electronic components four times faster than the best skilled operators using conventional test equipment, reports the company.

The new machine makes it possible for users to obtain transistors in quantity lots that have been presorted into the many categories which they desire.

To meet the needs of various transistor users, the machine first tests the new transistors and then divides them into four categories: computers, general purpose, entertainment and specials. Within the limits of these four groups, the tester then reads the qualities that determine where and how the transistors will be used. These include: alpha cut-off level, collector cut-off current at high and low voltage, "punch-through" voltage, emitter cut-off current at high and low voltage, minimum beta and input voltage.

In addition to reducing inspection costs, the machine can be operated by an unskilled employee.

Storatron Freezes Events For Hours

A one-inch storage tube that can "freeze" transient events for hours is expected to become an indispensable tool for military and scientific programs. Called the Storatron, the tube was developed by Du Mont Laboratories, Inc., of Clifton, N. J. Its principal feature is its ability to store transient events detected by radar, television, oscilloscopes, or produced by computers as they occur, and to read-out and hold the information on one or a multiple number of picture tube displays.

The Storatron, after storing the events, allows the information to be continually viewed remotely on all sizes and types of television picture tubes. This differs from the direct-view storage tube which stores the information and presents it on its own picture screen, and therefore should be particularly useful in applications such as missile reconnaisance, defense centers or where coordinated group efforts are involved.

According to the company, the special design of the Storatron permits longer read-out, eliminates the need for special photosensitive surfaces, reduces cost of production and does not limit the application to a specific frequency band.

IRE Salutes Government Research

Again government projects make the news as space satellites relay world weather data and rockets orbit the sun. The *Institute of Radio Engineers* salutes government contributions to progress in radio-electronics in the *Special May Issue* of **PROCEEDINGS OF THE IRE.**

The big May **PROCEEDINGS OF THE IRE** gives deserved recognition to the government laboratories and bureaus engaged in electronics research and development, and brings to its readers information about the invaluable work being done by engineers and technicians in federal employ. Included are 40 technical papers dealing with the most important aspects of current projects.

Radio-Electronics Behind the Headlines

This Special Issue reveals how the government is meeting the challenge of creating new and better electronic devices for peaceful and utilitarian purposes, as well as how it is meeting the pressing need for advanced national defense systems. Also discussed are future safeguards for the security of the free world.

Presentation of this special issue on *Government Research* is in keeping with the IRE's policy of bringing to the world of radio-electronics the latest news of subjects of special interest and significance. Such a practical policy enables the IRE to provide a valuable service to the industry by making technical material and pertinent information available not only to its 72,000 members, but to informed non-members as well.

Read this informative report on *Government Research* in the publication that records progress. If you are not a member of the IRE, be sure to reserve a copy of the May **PROCEEDINGS,** now.

PARTIAL CONTENTS OF THIS GOVERNMENT RESEARCH ISSUE:

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"The DOFL Microelectronics Program" by T. A. Pruge, J. R. Nall & N. J. Doctor, Diamond Ordinance Fuze Labs.

"VFL Propagation Measurements for the Radux-Omega Navigation System" by C J. Casselman, D. P. Heritage & M. L. Tibbals, U. S. Naval Electronics Lab.

"Submarine Communication Antenna Systems" by R. W. Turner, U. S. Naval Underwater Sound Lab.

"Some Characteristics of Persistent VHF Radio Wave Field Strengths Far Beyond the Radio Horizon" by L. A. Ames, E. J. Martin & T. F. Rogers, Air Force Cambridge Research Center

"Phenomena of Scintillation Noise in Radar Tracking Systems" by J. H. Dunn, D. D. Howard & A. M. King, U. S. Naval Research Lab.

"On Models of the Atmospheric Radio Refractive Index" by B. R. Bean & G. D. Thayer, National Bureau of Standards

"Image Intensifiers and Image Converters for Military and Scientific Use" by M. W. Klein, Engineering Res. & Dev. Labs.

"A Light-Weight and Self-Contained Airborne Navigational System" by Staff, Defense Research Board, Canada

"The CAA Doopler Omnirange" by S. R. Anderson & R. B. Flint, U. S. Dept. of Commerce

"Pulsed Analog Computer for Simulation of Aircraft" by F. N. Herzog, U. S. Naval Training Device Center

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"The Engineering of Communication Systems for Low Radio Frequencies" by J. S. Belrose, W. A. Hatton, C. A. McKerrow & R. S. Thain, Defense Research Board, Canada

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REMEMBERS THE MAN

Stereo Power Amplifier

A new 60-watt stereo power amplifier (Model SA-300) has recently been introduced by Fisher Radio Corporation of Long Island City. The unit contains two identical 30-watt amplifier channels to drive every type of stereo or multi-speaker monophonic system.

A number of engineering developments are featured in the new amplifier: an input for controlled frequency response in each channel, provision for matching low damping factors and the incorporation of a dual-bias circuit.

The controlled response is especially designed for electrostatic tweeters, which may overemphasize high frequencies and is also useful in reducing subsonic transients. The standard input frequency response of the SA-300 is uniform within ½ db over the entire audible range of 20 to 20,000 cycles. Hum and noise are more than 100 db below signal levels and are said to be completely inaudible. Harmonic distortion is less than 0.1% at full-rated output (+ 1 db), and IM distortion is below 0.08%.

The amplifier operates at 105-120 volts, 50-60 cycles and consumes 300 watts at full-rated power.

Advanced TV Tape Recorder

The development of a highly advanced TV tape recorder for color or black and white broadcasting has been announced by Radio Corporation of America. One of numerous new developments by RCA, the recorder is designed to turn out interchangeable tapes and contains a built-in cuing system to simplify the handling of TV tape material. With no modification of the original machine, the broadcaster can start with monochrome programming and include color at any time by the addition of a single rack of color-handling equipment.

According to a company official, the recorder is capable of producing tapes that can be used interchangeably with a standard recorder for syndication purposes. An electronic system permits precise adjustment of the electrical quadrature relationship among the four video record/playback heads. There are two such quadrature adjustments: one for recording, which permits production of tapes with uniform pattern quality, and the other for playback. During playback, the adjustment system can produce high quality pictures while using tapes from machines not in proper alignment at the time of recording and while the recorder is running.

The recorder has a variable speed cuing control to hasten locating a desired section of tape. Cue information can be entered during program recording by a separate erase head which does not disturb the main program material. A separate playback head allows the operator to monitor the audio channel a fraction of a second after audio information has been recorded.

The recorder contains a built-in picture monitor and a 5-inch cathode ray oscilloscope, serving as a waveform monitor and maintenance scope.

The main tape guide posts employ a technique in which air is forced through tiny holes so the tape rides on an air cushion. This serves to help eliminate tape scratches which may appear as picture streaks in playback.

Hi-Shock Switch and Plastic Mirror

The following two new products from Singer Military Products, Division of Singer Manufacturing Co. have recently been announced. They include a Hi-Shock Stepping Switch and a Repli-Mirror.

The new switch consists of a rotary actuator having a new rotary solenoid with 100 per cent rotary action, a ratchet mechanism and a rotary switch. Solenoid is actuated by a pulse on constant voltage by using a single set of controls inside the switch. Wafer construction permits various switching combinations with standard parts.

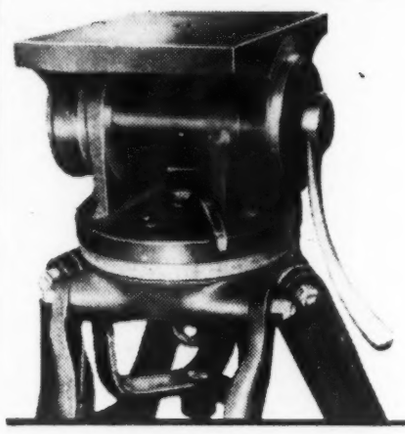
The Repli-Kote process is a means of rapid duplication of costly precision ground mirrors at a far lower cost than has been previously possible. Application of the new technique produces epoxy resin replicas from a glass master. Several important properties of the plastic replicas are superior to those of glass.

Ultrasonic Dishwasher

An ultrasonic dishwasher, called the "Polaris," that blasts dirt from dishes without chipping them was demonstrated by the Narda Ultrasonics Corporation of Mineola, L. I. at the recent IRE Show in New York.

To industry, the ultrasonic washer, rinser and dryer offers a valuable saving in manpower, time and money. Aircraft engine oil strainers and other greasy components can be cleaned at the rate of 300 to 400 in an eight-hour period due to a two-stage push-button controlled ultrasonic vapor

CECO microwave relays conquer space barriers



Whether it's a fixed station or a mobile unit, CECO microwave equipment surmounts the communication barrier. Because CECO equipment is built to a quality that is actually higher than the official standards. For dependable pickup and relay under adverse climatic conditions, you're wise to play safe with CECO.

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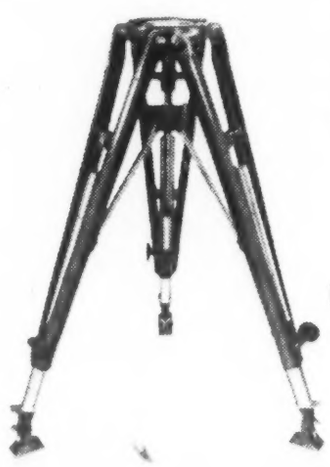

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degreaser. Conventional hand-cleaning methods, requiring inspection, complete disassembly and reassembly took eight hours to fully clean only six to eight oil strainers.

Combining sound pitched too high for the human to hear and for ordinary detergents, the ultrasonic washer operates on the same principle as a babbling brook. Sound-agitated water or solvents cause thousands of tiny bubbles to form and explode with tremendous force, virtually "blasting off" all foreign matter from items being washed.

DC Generators

An extended line of DC generators, ranging from 500 watts to 40 kw and containing a wide variety of voltages, is now available from Kato Manufacturing Company of Mankato, Minnesota.

A wide range of applications including battery charging and testing and operating of DC appliances are possible due to the availability of shunt and compound wound units.

The generator has commutating poles, in addition to the field poles which improve commutation as the constant location of the commutating zone is maintained, regardless of load changes. Brush sparking is greatly reduced and over-all generator performance is improved, the company reports. DC current which is provided for cathodic protection, reduces underground pipe corrosion.

Construction features include heavy cast endbells and frame, grease-sealed ball bearings and single segment commutator bars. Laminations are punched from high quality dielectric steels. Coils are heavily insulated, banded and thoroughly impregnated with thermosetting varnish, making the armature a solid mass.

Memory Master

Announcement of an economical magnetic tape machine than can read or write 30,000 characters per second, has been made by ITT Laboratories of Nutley, New Jersey. According to the company, the machine could be combined in a system, called tape transports, to record and store all 24 volumes of a standard encyclopedia and locate any paragraph in seconds. Bidirectional to speed access time, the transport spins tape past its read-write head assembly at 500 feet per minute.

The machine is able to reverse direction and attain full speed in less than 5/1000 of a second. The width of the tape and its packing density are combined with the storage arrangement and speed of the machine to provide storage capacity equal to conventional tapes 3 to 5 times as long.

Of simple, rugged design, with no vacuum tubes and few moving parts, the device can be integrated into almost any electronic filing or storage system, regardless of size or complexity.

A companion automatic tape transport tester, that simulates the specific application of each machine, has also been developed to test the units.

Largest "Hi-Fi"

A "hi-fi" amplifier, with an output capacity of 200,000 watts — about 20,000 times more powerful than most home high fidelity radio-phonographs—has been built to test components and subassemblies of the Navy's Polaris missile.

The industrial electronics department of Westinghouse Electric Corporation constructed the device and it will be used by Lockheed Aircraft Corporation at their plant in Sunnyvale, Calif.

"Although it is perfectly capable of providing good music reproduction at this power level of 200,000 watts," a Westinghouse spokesman said, "the amplifier is actually going to be used to boost vibration coming from some of the most raucous and unpleasant noise that it is possible to reproduce."

However, none of this noise output from the amplifier is intended to be audible even for peak operations.

Instead of being connected to a conventional speaker system, the amplifier will cause vibration of a platform which has a missile part attached.

"With this amplifier, it will be possible to test missile components to destruction if necessary in order to establish how much vibration the parts can withstand," the Westinghouse official said. It would be possible to "play" the tape recordings of vibration from a recovered missile through the amplifier to test components on the ground under conditions that duplicate those in flight.

"If you could connect this amplifier to some king-sized speaker system, you could probably carry on a conversation with a friend three counties away," the spokesman added.

The amplifier is valued at over $100,000, weighs about 10 tons and at full power will need as much electricity as several hundred average homes.

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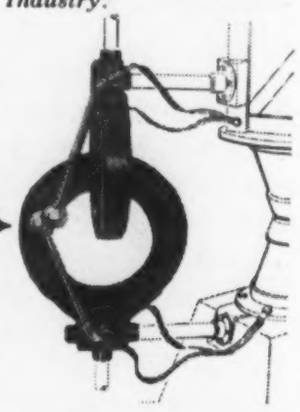

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Portable Electronic Larynx

Over 40,000 people who have lost the use of their vocal chords but who retain the ability to form sounds by shaping their mouths and lips should now be able to speak intelligibly without a great deal of effort. According to Gulton Industries of Metuchen, N. J., producers of the Electro-Larynx, this is due to the new portable hand-operated instrument that artificially vibrates a column of air in the esophagus from which normal speaking sounds can be produced.

According to its developers, Kett Engineering of Santa Monica, Calif., the device can be mastered in a half-hour and is extremely simple to operate. The Electro-Larynx is held firmly against the throat so that the vibrating grid is near the adam's apple. A switch is pressed and a mechanical sound is produced in the throat cavity that reproduces the original sound produced by the larynx and can be modulated into intelligible speech.

The new model (Mark III) features nickel cadmium batteries which activate the vibrator and which are life-time rechargable batteries. Supplied with two batteries, the unit is reported to operate for an entire day on one battery while the other is being recharged in the recharging unit provided in the carrying case.

The device weighs less than one pound and is smaller than a standard household flashlight.

New Literature

New Magazine In Ultrasonics

Ultrasoundings is the name of a new magazine containing information of general interest in the ultrasonics field as well as about applications of ultrasonics by industry, service organizations, medical establishments and the military. It is published quarterly by Acoustica Associates, Inc., 26 Windsor Ave., Mineola, L. I., New York, and is available free by writing to the company.

Autrometer Booklet

A new booklet containing complete engineering data on the instrument that employs a universal detector and automatic crystal changer to provide a fast, non-destructive analysis method for as many as 24 elements in a single sample is now available.

Entitled *Norelco Autrometer, Automatic Indexing X-ray Spectrograph*, the 8-page brochure is published by the Instruments Division of Phillips Electronics, Inc., 750 South Fulton Avenue, Mount Vernon, New York, and may be obtained free by writing to the company.

Dealing with applications, operating principles and procedures, performance, calibration, reproducibility, automatic programming and statistical accuracy, the booklet also includes specifications for the main chassis, transformer, console and water and power supplies.

High Speed Electronic Printer

A high-speed electronic printer for digital computer output, which can write 12 characters in parallel across a 5-inch chart at a speed of 2160 characters per second, is described in a report of Air Force-sponsored research just released to industry.

The printer has a single timer unit, a single numeric function generator and 12 identical character elements. Each character unit has the necessary circuitry to produce any decimal digit 0-9, a minus sign and a decimal point. With the addition of 24 character elements and minor design changes, up to 36 columns of characters can be printed. An increase in the amount of characters printed per second may be achieved simply by increasing the chart speed. With the use of an analog-to-digital converter in the input of the printer, it could operate in conjunction with analog computers. The amount of printable characters available is said to be unlimited.

The report (PB 151331) may be ordered from OTS, U. S. Department of Commerce, Washington 25, D. C., for $2.50.

Electronic Tube & Microwave Equipment

Recently published by the Sperry Microwave Electronics Co. and the Sperry Gyroscope Co., divisions of Sperry Rand Corporation in Great Neck, New York, are two condensed catalogs of new equipment in the microwave and electronic tube fields.

Brief descriptions and specifications for such items as traveling wave tubes, amplifier, reflex oscillator and multiplier klystrons are contained in the booklet on electronic tubes.

The catalog on microwave equipment contains similar descriptions pertaining to antennas and components, microwave subsystems, automatic checkout equipment, ferromagnetic devices and various other equipment for military and commercial systems. Both catalogs may be obtained by writing to the Public Information Office of either company in Great Neck.

Microwave Test Equipment

FXR, Inc., who offers a wide selection of microwave test equipment, is now distributing a new Short Form Catalog which contains listings of all components and their prices.

Waveguide components, coaxial components, instrumentation and high-power pulse modulators are described and listed separately. Sufficient technical data and illustrations are included for the microwave engineer's basic information. Other details, including prices, should enable purchasing agents to select the model numbers of desired equipment and to determine their costs.

Copies of the catalog are obtainable upon request from FXR, Inc., 26-12 Borough Place, Woodside 77, New York.

Computer Applications Symposium

Proceedings of the 1958 Computer Applications Symposium, held last October in Chicago, are now available. The publication includes 14 papers presented at the conference and transcripts of panel discussions at the conclusion of each day's technical sessions.

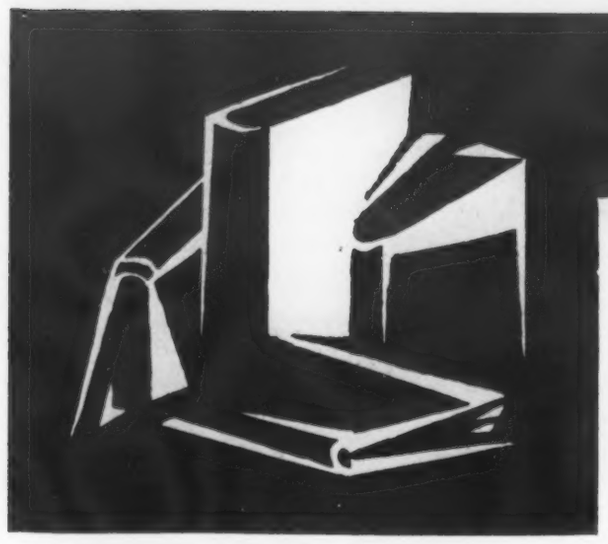
Price of the publication is $3.00 a copy, and may be obtained by writing to Armour Research Foundation, Main Files: CA-5, 10 West 35th St., Chicago 16, Ill.

RCA Receiving Tube Manual

A new revised edition of the "RCA Receiving Tube Manual," an authoritative and comprehensive technical text which has sold over 3½ million copies of earlier editions, has been announced by the RCA Electron Tube Division.

The principal sections of the book include: technical data for more than 625 receiving tubes, covering types for black-and-white and color television and series-string applications; basic tube theory and application; an expansion of information on electron tube applications with a description of tone-control circuits for hi-fi audio amplifiers and high-voltage regulator circuits for TV horizontal deflections systems, and various other sections containing information on generic tube types, interpretation of tube data and electron tube installation.

Copies of the manual (RC-19) can be obtained from RCA Tube Distributors or from Commercial Engineering, RCA Electron Tube Division, Harrison, N. J., for 75¢.



Books

COLLISION COURSE, by Alvin Moscow. G. P. Putnam's Sons, New York. 309 pages, $4.50.

The entire course of western civilization can be followed through the records of the sea: naval battles, disaster, exploration, discovery and trade. On July 26, 1956, at 11:10 p.m., a new chapter was added with the collision of the Italian luxury liner, the *Andrea Doria*, and the Swedish passenger ship *Stockholm*. Two of the newest ships on the ocean, each equipped with modern radar and each commanded by captains with over 25 years of experience, were traveling on routine voyages with several miles of the Atlantic Ocean between them as passing room. And yet they crashed. Why? How?

Mr. Moscow relates with accuracy and vigor the almost unbelievable facts leading up to the greatest sea tragedy in over 45 years, the technical and human elements of the rescue, the sinking of the *Doria*—$30,000,000 worth of art and luxury—the hearings and little known facts about the operation of steamship companies, their costs, their demanding schedules and the unwritten moral code of seamen.

Appearing out of a dense fog, some miles from the Nantucket lightship and heading west, the *Andrea Doria* veered sharply to port. At approximately the same moment, the *Stockholm*, heading east, turned starboard and, within seconds, the bow of the Swedish liner had torn a gaping hole 40 feet wide in the starboard side of the *Doria*. The list was serious and immediate; by 10:00 the next morning the *Doria* was at the bottom of 225 feet of water. The purpose of both turns had been to increase the safe passing distance between the ships; the crucial discrepancy lies in the fact that the officer on the *Doria* sighted the *Stockholm* on its starboard, and Third Officer Carstens of the *Stockholm* sighted the *Doria* traveling almost parallel and to its port.

The author reports these facts as objectively as possible, and yet if the radar was not at fault, human error is all that remains; both ships could not have been right. The author does not offer any value judgment; nor did the hearings clearly establish that one ship was more at fault than the other. But one cannot help but draw the inference from Mr. Moscow's presentation that the *Doria*, especially, was far from blameless.

The training of the Italian Line's officers in the field of radar was meager, and they did not precisely plot the course of the oncoming ship; Captain Calamai admitted he trusted more to instinct and experience than radar; the essential logs and records went down with the ship due to a misunderstanding of orders; 200 of the crew were among the first to be rescued, and the *Andrea Doria* was traveling at full speed through a dense fog in order to meet a schedule and pare costs. Yet, the more one searches for the cause of the collision, the more one must feel the tragedy of the loss of the ship that symbolized Italy's "renaissance as a seafaring nation."

Sympathy alone, however, cannot prevent future maritime disasters. One important result of the hearings was a review of the safety and stability regulations for the building and operation of ships, as well as a demand for thorough training by ships' officers in the use of radar. The recent collision of the passenger ship, *Santa Rosa*, and the tanker, *Valchem*, under remarkably similar circumstances, reasserts the need—perhaps long overdue—for such constructive action.

GARDNER'S PHOTOGRAPHIC SKETCH BOOK OF THE CIVIL WAR, by Alexander Gardner. Dover Publications, Inc., New York. $6.00.

A valuable historical document is to be found in this complete republication of Alexander Gardner's original sketch book, published in 1866. A contemporary and associate of Matthew Brady, more commonly known as "Lincoln's Photographer," Gardner compiled numerous photographs taken by him and members of his organization of almost every aspect of the Civil War. There are no more than 10 copies of the original print in existence.

Included in the reprint, are 100 photographs, many which have never been reproduced before in any form. Accompanying each photograph is a full introduction and comment (retained from the original) on the picture and its broader meaning, that assumes the factual and historical importance of a contemporary report.

Crucial battle scenes such as Antietam, Appomattox, Manassas, Mechanicsville, Bull Run, Yorktown and many others are depicted with a reality true to one of the bloodiest wars in history. There are photographs of Gettysburg immediately after the retirement of troops, and battle ruins at Richmond, Petersburg and Gaines' Mill. Important buildings, establishments, prison arsenals, fortifications, headquarters and a slave pen at Alexandria, groups of soldiers, pontoon bridges, a medical supply boat field hospital, confederate and union dead and scores of others emphasize the factual reporting prevalent in the period.

This new edition includes full documentation on each photograph, indicating the maker of both the negative and positive plates. An extensive index has been added and the new introduction provides the reader with a general background to the collection, as well as an explanation of the nature of photographic processes at the time of the Civil War.

DICTIONARY OF ASTRONOMY AND ASTRONAUTICS, by Armand Spitz and Frank Gaynor. Philosophical Library, New York. 436 pages, $6.00.

As every rocket rises from its launching pad, as the giant telescopes "see" further and further, as science fiction becomes reality, new words enter the language and new definitions, that are readily available, become essential. *The Dictionary of Astronomy and Astronautics* attempts to provide a previously unavailable reference work, not to take the place of others, but to provide in a single source definitions of terms so frequently appearing in the headlines today.

For those who do not have easy access to complete technical libraries, this work contains informative illustrations and concise definitions of over 2,200 terms and concepts related to astronomy and astronautics, a wide gamut of terms ranging from those as old as man to those as new as the Space Age on the threshold of which he now stands.

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All insignia may be ordered from: AFCEA Service Dept., 1624 Eye St., N. W., Washington 6, D. C.

Personnel Available

As a service to AFCEA members, SIGNAL will make space available in this column for those members who are interested in employment in the communications, electronics and photography industries. Any member is entitled to three insertions in the magazine on a space available basis, free of charge. Please limit your notice to 5 lines. In replying, employers are asked to address: Box ....., SIGNAL 1624 Eye St., N. W., Washington 6, D. C. Letters will be forwarded to the AFCEA member.

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CAPTAIN, ED, USN, electronics, retiring Aug. 1959, age 48, wishes to apply results of over 16 years broad responsible experience in management of engineers to problems of private industry. Post card brings detailed résumé. Box 149.

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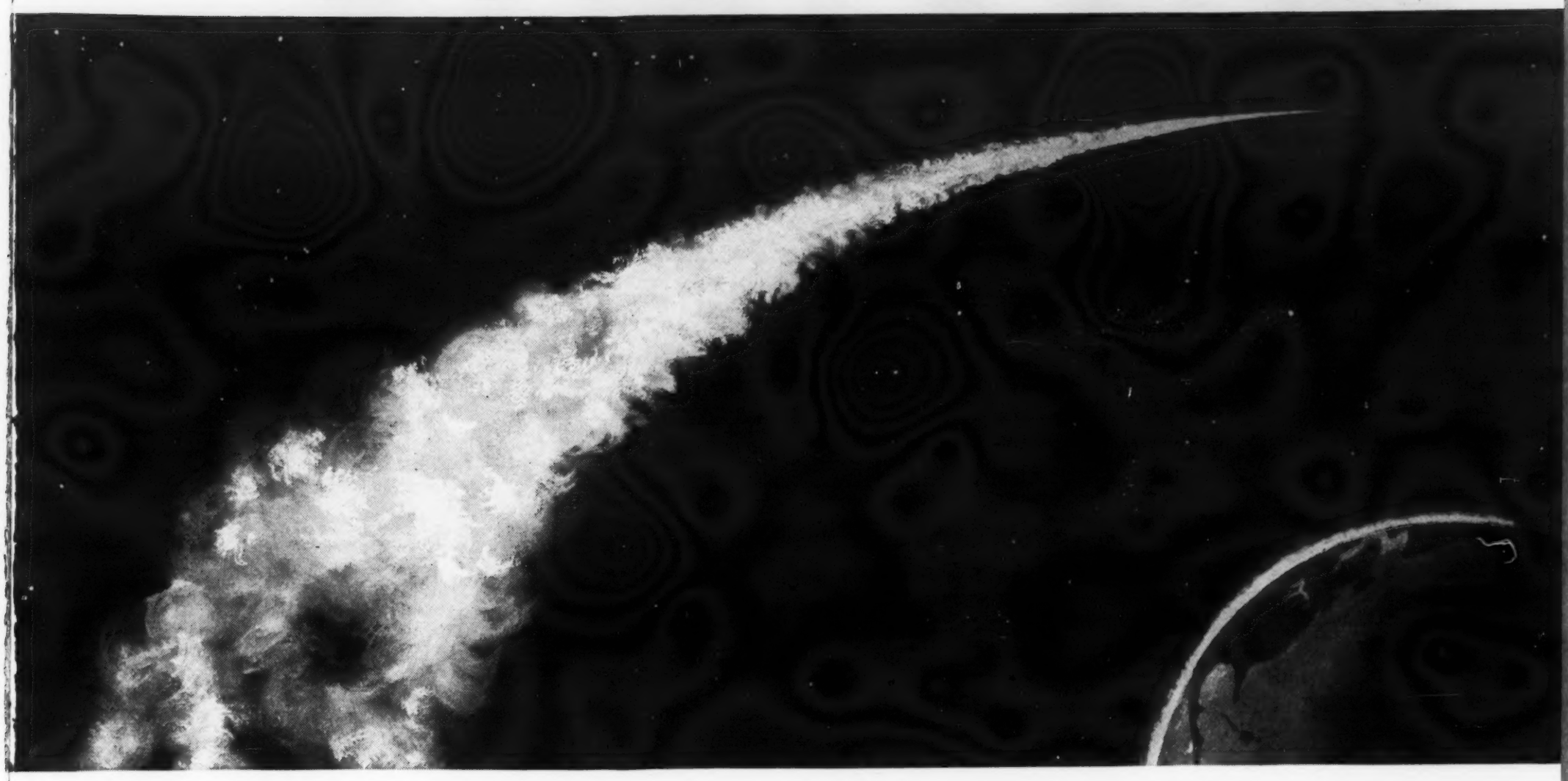
DYNA-SOAR



Dyna-Soar (for dynamic soaring) is a joint project between the Air Force and the NASA, and is an attempt to solve the technical problems of manned flight in the sub-orbital regions. Advance knowledge on the project indicates how a boost-glide vehicle can operate from the outer fringes of the atmosphere where it can maneuver and be recovered undamaged. Studies show that by varying the original rocket boost, and thus the velocity, and with the control available to the pilot, the Dyna-Soar aircraft can circumnavigate the earth, followed by a normal and controlled landing. Boeing Airplane Company, one of the competing companies for the development contract for the complete boost-glide system, has delegated to RCA the responsibility for the development of important electronic components of Dyna-Soar.

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BL-223
BL-226
BL-227
BL-228
BL-230
BL-231
BL-233
BL-242
BL-243
BL-245
BL-247
BL-250
BL-M003
BL-M004
BL-M007
BL-M008

BOMAC BEACON MAGNETRONS

Tube	Ef Volts	If Amps	Peak Anode Voltage	Peak Anode Current Amps	Peak Power Watts	Frequency Mcs	Output Mates To	Weight	Band
BL-212	5.0	0.5	1200 V	0.8	100	5400–5900	50Ω SM Jack	8 oz.	C
BL-223	5.0	0.7	1900 V	1.1	400	5400–5900	50Ω TNC Plug	10 oz.	C
BL-226	5.0	0.5	1300 V	0.9	100	9100–9500	50Ω TNC Plug	8 oz.	X
BL-227	5.0	0.5	1300 V	0.9	100	8700–9100	50Ω TNC Plug	8 oz.	X
BL-228	5.0	0.5	1300 V	0.9	100	8300–8700	50Ω TNC Plug	8 oz.	X
BL-230	5.0	0.7	2800 V	1.9	1000	5400–5900	50Ω TNC Plug	10 oz.	C
BL-231	5.0	0.5	1450 V	1.0	200	5400–5900	50Ω SM Jack	8 oz.	C
BL-233	5.0	0.7	2800 V	1.5	1000	9375	UG 40/U	11 oz.	X
BL-242	5.0	0.7	1900 V	1.1	400	5400–5900	TNC or 50Ω N Plug	10 oz.	C
BL-243	5.0	0.5	1450 V	1.0	200	5400–5900	50Ω SM Jack	8 oz.	C
BL-245	5.0	0.7	2800 V	1.9	900	5400–5900	50Ω TNC Plug	10 oz.	C
BL-247	5.0	0.5	1200 V	0.8	100	9100–9500	50Ω TNC Plug	8 oz.	X
BL-250	5.0	0.5	1350 V	1.0	150	5400–5900	50Ω TNC Plug	8 oz.	C
BL-M003	5.0	0.5	1300 V	0.9	100	9100–9500	50Ω TNC Plug	7 oz.	X
BL-M004	5.0	0.5	1200 V	0.9	150	8900–9100	50Ω TNC Plug	8 oz.	X
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